MEXICAN MAQUILADORAS:
EVIDENCE FROM PLANT- LEVEL PANEL DATA

by

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Mexican Maquiladoras: Evidence from Plant-level Panel Data

Thesis directed by Associate Professor Hale Utar

The first chapter presents a detailed description of the Mexican maquiladora industry plant level information. The main objective of the first chapter is to present a detailed description of the maquiladora plant level information that will be used in succeeding dissertation research. In addition, the first chapter is intended to serve as a guide to the sorts of information available from INEGI. In the second chapter I analyze with my co-author Hale Utar the impact of intensified competition from China on Mexican export assembly plants (maquiladoras) using plant-level panel data covering the period from 1990 to 2006. By using the WTO accession of China as a quasi-natural experiment, our difference in difference approach reveals a significant effect of Chinese competition on within plant productivity improvement of maquiladoras. We also find a positive and significant impact of the heightened competition on productivity through entry but not through exit. Although competition from China also has negative and significant impact on plants' growth, we do not find a major effect on plant exits. In the third and final chapter, I investigate the trends toward and away from feminization in the maquiladora industry. It presents analysis of women's work and earnings in Mexican export assembly plants between 1990 and 2005. This is done for eleven manufacturing industries and a service industry. The association between feminization on earnings disparities of male and female workers is also investigated. A descriptive analysis of the information shows that overall the participation of women workers in all 12 industries has dropped, while during the same period, plant skill intensity has increased. In addition, estimates indicate that female workers receive lower wages than male workers. Were the descriptive analysis of the information also shows that the earning wage gap between men and women works has increased from 1997 to 2005. This trend is observed in all 12 of the maquiladora industries.

I dedicate my dissertation to my wife Tamara and my children Camila and Paulo Bernardo.

Thank you my love, Tamara my wife, for being proud and supportive of my work and who has shared the many uncertainties, challenges and sacrifices for completing this dissertation and who has encourage me for the past three years to achieve this goal.

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Despite all the assistance provided by my esteemed advisor Hale Utar and others. I alone remain responsible for the content of the following dissertation, including any errors or omissions which may unwittingly remain.

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CHAPTER I

THE MAQUILADORA INDUSTRY INFORMATION

1.1 Introduction

Information about the maquiladora export industry is a project generated by el Instituto Nacional De Estadística, Geografia e Informatica (INEGI), whose objective is to provide statistical information on the behavior and evolution of the major variables of the Mexican maquiladora industry.

INEGI has begun granting access to its micro-economic data sets from the manufacturing industries surveys and other statistical information. Access to INEGI´s micro economic data sets can only be accomplished at its main offices in Aguascalientes and/or Mexico City in adherence with confidentiality laws. Most recently, it granted access to the Mexican manufacturing surveys at its Aguascalientes offices to Verghoogen (2008) and Iacovane (2008). In regard, to the maquiladora plant level information it can only be accessed in the Mexico City offices. Prior to my visit to INEGI´s Mexico City´s offices authorization clearance was granted by INEGI officials to set up the agenda for my visit. During many months I had the opportunity to consult with INEGI´s analysts and experts regarding methodologies for collecting, processing and revising the information. This allowed me to understand the dynamics of the maquiladora information and how to better proceed in subsequent empirical analysis.

The main objective of this paper is to present a detailed description of the maquiladora plant level information that will be used in succeeding dissertation research. In addition, this paper is intended to serve as a guide to the sorts of information available from INEGI. This

institution continues to improve the availability and access to its data sets, and its contribution to research has been outstanding.

In the remainder of the paper, the background of the maquiladora statistics will be discussed, then the methodology for gathering data and coverage of the maquiladora industry data. Next, the NAICS matching will be presented, followed by a discussion of content and data management. Finally, conclusions will be presented.

1.2 Background

Derived from the Arabic "maquila", the word was initially related to grain mills, where the owner charged for processing grain from the agricultural producers. The meaning of the term evolved to intend any activity done by a third party – not the original manufacturer -- of any industrial process, like assembly. The maquiladora industry emerged in Mexico during the 1960s as an economic answer to wage increases in highly industrialized countries like Japan and the United States. In May of 1965 the Federal Government establishes the Policy to Support the Maquiladora Industry in the northern part of Mexico as part of the Border Industrialization Program. The Policy instituted that firms belonging to the maquiladora program are responsible for: (1) generating employment; (2) strengthening the Balance of Payments through foreign exchange; (3) contributing in the improvement of the international competitiveness of the national industry and training of its workers; (4) as well to propel the development and the technology transference in the country. These objectives continue to be valid under the current Decree that was signed in1998 to Support and Operate the Export Maquiladora Industry.

In 1966 the program is formalized and the first industrial park is built in the border city of Juarez in the state of Chihuahua. The first firm established in the Juarez industrial park was a firm dedicated to manufacturing televisions. In 1968 the second industrial park is built in the border city of Nogales in the state of Sonora. The park attracted a firm dedicated to plastic manufacturing to establish operations. By 1973, various industrial parks were built along the Mexican Border. In the Border State of Baja California approximately 102 firms were distributed between the cities of Ensenada, Mexicali, and Tecate y Tijuana. In the border state of Tamaulipas 56 firms established themselves along the border cities of Nuevo Laredo, Reynosa and Matamoros. In the state of Sonora 40 firms establish themselves in the border cities of Nogales, Agua Prieta and San Luis Rio Colorado and in the border state of Coahuila twelve firms establish themselves in the border cities of Acuña and Agua Prieta. The first maquiladoras were located along the Mexican border cities and states. Location played an important role, but also the maquiladora program did not allow maquiladoras setting up in non-border locations. The Customs Laws in Mexico on the 15th of March of 1971 are modified to include maquiladora activities and in 1972 the first changes are made to include the maquiladora program in the rest of the country. Also, the first Work Group is formed for the maquiladora industry during the same year until its disappearance in 1998 that coincides with the signing of the decree to support the maquiladora industry.

Since 1973, the General Department of Statistics (DGE) has been in charge of estimating and publishing information about the maquiladoras. Today, the General Department of National Accounts and Economic Statistics from INEGI is responsible for these activities through its Department of Exterior Commercial Statistics, Administrative and Pricing Registry. The departments offices are located in Mexico City where the planning, the conceptual and

methodological designed are realized. The statistics were estimated quarterly from 1973 to 1977, then after 1978 they were published monthly. During the period between 1975 and 1978 only seven product groups were assessed; only after 1979 was the classification expanded to include twelve groups. In 1986 the "Estadistica de la Industria Maquiladora de Exportacion 1975-1984" is published and is considered the first edited publication by the part of INEGI. This started the monthly estimation of the Estadistica de la Industria Maquiladora de Exportacion (EIME) until 2006. After 2006 a regulatory change was made that merged the maquiladora program with an export-oriented program for domestic companies known as the Program for Temporary Imports to Promote Exports (PITEX). The new program is called Maquiladora Manufacturing Industry and Export Services (IMMEX). As a result, INEGI stopped reporting maquiladora data after March 2007, and the data was merged with IMMEX data.

1.3 Methodology and Coverage

The EIME considers the individual maquiladora establishment/plant to be the unit of observation, defined as an economic unit with a unique physical location, established in a permanent location and delimited by construction and fix installations, under one owner or control, performing industrial processes or services destined to transform, assemble or repair merchandise imported temporarily that derive into the production of goods and services for their export and/or sale in the national market. The international recommendations that are used in the estimation of the maquiladora industry statistics are the ones established by the United Nations in its World Program of Basic International Surveys and Industrial Statistics parts I, II and III. The maquiladora industry information publishes monthly and annual results; its coverage is at a

national level that includes results for states and cities and by maquiladora products. The maquiladora industry statistics considers eight chapters:

1. Number of Establishments
2. Occupied Personnel
3. Salaries and Wages paid to the Personnel
4. Man Hours and Days Worked
5. Consumed Inputs
6. Various Expenditures
7. Gross Profits
8. Value Added in the Maquila Process

To be considered a maquiladora establishment/plant it must have authorization from the Secretary of the Economy to be a participant in the Maquiladora Export Program. All maquiladoras are obligated to fill out questionnaires for the EIME. They submit the completed questionnaires by mail to the INEGI offices or by internet through INEGI´s website. During the estimation process 10 regional departments as well as state coordination offices are involved in the local planning and the monitoring of each individual maquiladora firm. This micro-level information is used to compile the aggregate maquiladora statistics by industry and region, as well as nationally. The industry classification for these statistics is done for twelve product groups, of which eleven are manufacturing industries and the twelfth a collection of various service industries. It covers all maquiladora establishments in both border and non-border locations. Although every plant in the maquiladora program is legally required to answer the questionnaire, some plants either do not respond or answer it incompletely. Further characterization of plants as non-responsive and removed is being pursued in congruence with INEGI´s recommendations.

An unbalanced plant-level data set was constructed for the maquiladora industry from 1990 to 2006. The data set consists of 29,705 plant year observations that include 4,164 plants and 1,551 firms. It includes twelve product groups – eleven manufacturing industries and one service industry – and seventeen maquiladora industry cities. The cities included are considered the major maquiladora establishment sites, given that they have been primary locations for the maquiladora industry for years. They include all border regions where the maquiladoras are located. The panel data set represents on average 73.1% of total employment and 73.4% of total export valued added for the maquiladora industry from 1990-2006 (See Graph 1 & 2).

1.4 Industrial Matching

As mentioned previously, the industrial classification used by the EIME is for twelve product groups. The Department of Exterior Commercial Statistics, Administrative and Pricing Registry of INEGI have described the twelve groups in terms of their NAICS classifications:

1. **Selection, preparation and canning of foods**

Manufacturing and assembly of food that freezes and uses the preservation processes, such as pickling, canning, and dehydrating

3114 Fruit and Vegetable Preserving and Specialty Food Manufacturing

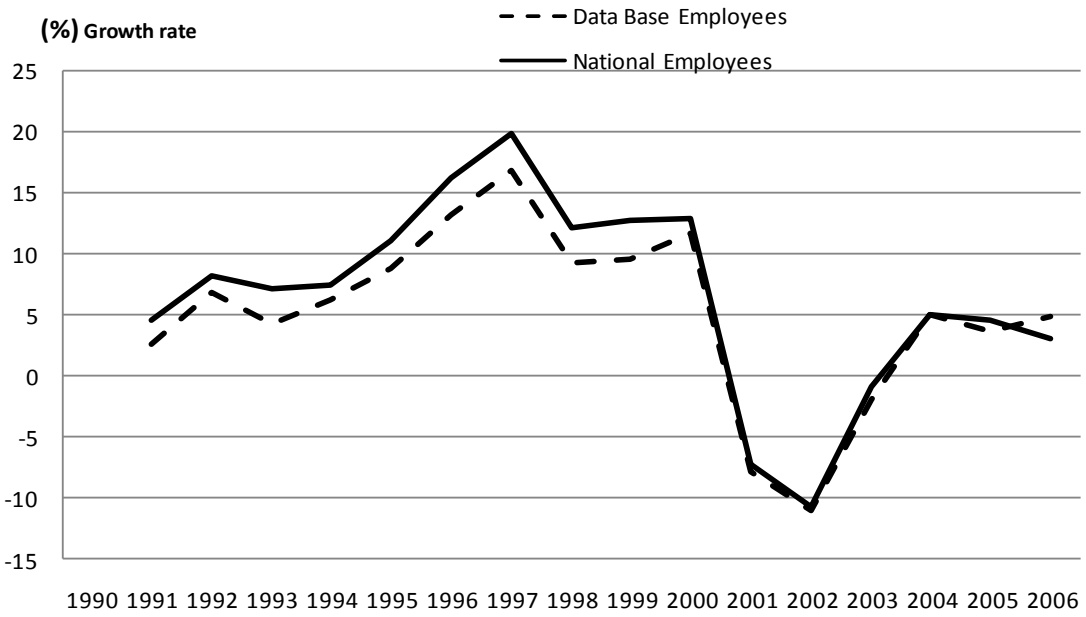
2. **Apparel and textile knitting and sewing**

Manufacturing and assembly of apparel processes that cut and sew (i.e., purchasing fabric and cutting and sewing to make a garment), and the manufacture of garments in establishments that first knit fabric and then cut and sew the fabric into a garment.

3151 Apparel Knitting Mills

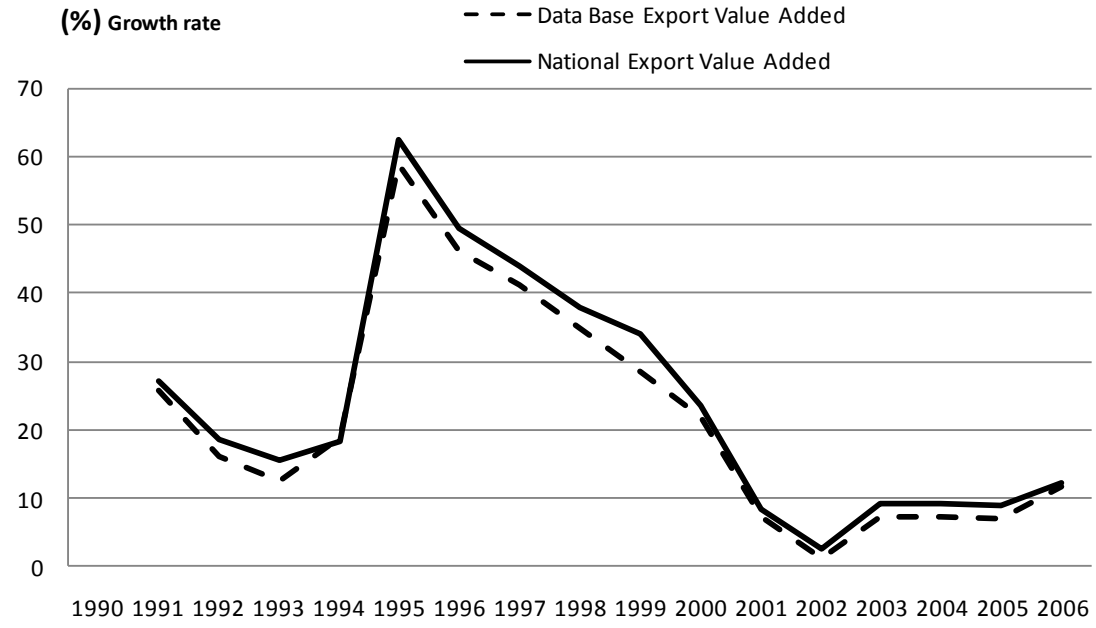
3152 Cut and sew apparel manufacturing

Graph 1 Employees: Maquila Industry Total and Aggregate Plant-level



Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation

Graph 2 Export Value Added: Maquila Industry Total and Aggregate Plant-level



Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation

3159 Accessories and other apparel manufacturing

3169 Other apparel manufacturing

3. **Footwear manufacturing and leather and hide tanning**

Transform hides into leather by tanning or curing and fabricating the leather into products for final consumption. It also includes the manufacture of similar products from other materials, including products (except apparel) made from "leather substitutes," such as rubber, plastics, or textiles

3161 Leather and hide tanning and finishing

3162 Footwear manufacturing

4. **Furniture and other wood and metal products assembly**

Manufacturing and assembly of wood construction products, containers, wooden utensils for domestic and industrial use, and wooden and metal furnishings assembly for general use

3323 Architectural and structural metals manufacturing.

3371 Household and institutional furniture manufacturing.

3379 Other furniture related product manufacturing

5. **Chemical products**

Manufacturing and assembly of rubber-based products, synthetic resins, fertilizers, pesticides and other agro-chemicals, pharmaceutical products; manufacturing of cleaning chemical products

3251 Basic chemical manufacturing

3252 Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments

3253 Agricultural chemical manufacturing

3254 Pharmaceutical and Medicine

3255 Paint, coating, and adhesive manufacturing

3256 Soap, Cleaning Compound, and Toilet Preparation

6. **Manufacturing, re-manufacturing and transportation (and accessories) equipment assembly**

Manufacturing and assembly of mechanical parts and seats, electrical and electronic equipment for motorized vehicles; manufacturing and assembly of brakes and transmission parts.

3362 Motor Vehicle Body and Trailer Manufacturing

3363 Motor vehicle parts manufacturing

3369Other Transportation Equipment

7. **Assembly and repair of tools, equipment and parts, except electrical**

Manufacturing and assembly of machinery and equipment for agricultural activities, construction and general industrial use; manufacturing and assembly of commercial and/or industrial HVAC and refrigeration systems.

3331 Agriculture, Construction, and Mining Machinery

3332 Industrial machinery manufacturing HVAC and commercial refrigeration

3334 HVAC and commercial refrigeration equipment

3339 Other general purpose machinery manufacturing

8. **Assembly of machinery and equipment electrical and electronic devices**

Manufacturing and assembly of computer and communications equipment, audio and video, navigation and measurement instruments, magnetic and optic media and household appliances.

3341 Computer and Peripheral Equipment Manufacturing

3342 Communications Equipment Manufacturing

3343 Audio and video equipment manufacturing

3344 Semiconductor and electronic component manufacturing

3345 Electronic instrument manufacturing

3346 Manufacturing and Reproducing Magnetic and Optical Media

3351 Electric lighting equipment manufacturing

3352 Household appliance manufacturing

3353 Electrical equipment manufacturing

3359 Other electrical equipment and component manufacturing

9. Electronic and electric materials and accessories

Manufacturing and assembly of lighting accessories, electric current/energy generating and distribution equipment, manufacturing of accessories for installing electrical fuses, contacts, plugs and boxed enclosures, etc.

3351 Electrical Equipment Manufacturing

3353 Electrical equipment manufacturing

3359 Other electrical equipment and component manufacturing

10. Sporting goods and toy assembly

Manufacturing and assembly of sporting goods and toy products

339920 Sporting goods manufacturing

339931 Toy, doll, stuffed toys, manufacturing

339932 Toys furniture and household type equipment (except dolls, stuffed toys) manufacturing

11. Other manufacturing industries

Manufacturing and equipment and material assembly for medical use, manufacturing and assembly of musical instruments, writing accessories and implements, drafting and office product-related activities, as well as products not previously specified.

334510 Medical clearing equipment and ultrasonic manufacturing

3391 Medical equipment and supplies manufacturing

3399 Other miscellaneous manufacturing

339992 Music instrument manufacturing

12. Services

Coupon counting, selection and processing, as well as merchandise inventory, industrial fabric dying and dry cleaning and laundering services; chemical testing, lab work, and waste collection, treatment, disposal and recycling of hazardous and non-hazardous waste.

541380 Testing Laboratories

561990 Coupon Processing Services

5621 Waste collection

5622 Waste treatment and disposal

5629 Remediation and other waste services

8123 Dry-cleaning and laundry services

In addition, based on Jon Haveman´s Industry Concordances and work done by Ma & Wooster (2008) export trade data in 2-digit Harmonized System (HS) as estimated by Banco de Mexico was converted to 3-digit NAICS. This was done to re-check the validity of the matching. Also previous research efforts (Bergin, Feenstra and Hanson, 2007; Cañas, Coronado and Gilmer, 2005) were used as references for industry matching.

1.5 Content

The data includes information on: employees, salaries paid to employees, man-hours, days worked, inputs consumed, various expenditures, gross profits and export value added of each maquiladora establishments. The data does not include information on: total sales, on capital equipment, or details on country ownership. The data in detail:

- **Employees**

Refers to employees (workers (production), technicians (production) and administrative employees)) permanent and temporal that work in the establishment or outside it, under its direction and control.

- **Workers (production)**

Personal that do work linked with the operation of the machinery in the maquila processes; line supervisors; as well as personnel linked to auxiliary tasks to the production process, dedicated to the supply of raw materials, packing, dispatch, storage, maintenance and cleaning of the plant, transportation, etc.

- **Technicians (production)**

Personal whose work is related directly with the processes of production or assembly and are not considered production workers, as an example, operation supervisors, quality control, organization and allocation of work to be done, etc. It includes foreign personal if their salaries are paid in Mexico by each establishment.

- **Administrative Employees**

Personal that carry out office work, administration, accounting, auxiliary activities and complementary; as well as executives, of planning, organization, direction and control. It includes foreign personal if their salaries are paid in Mexico by each establishment.

- **Salaries Paid to Employees**

Are all the payments and contributions in money and kind made before any deduction, payment for normal and extraordinary services rendered, in the form of salaries and social benefits and profits distributed to the personnel. This could be calculated in the basis of hours worked or on the quantity of worked done (piecework).

- **Salaries Paid to Workers(production)**

Is the total amount of all the money payments, before any deduction, payment for normal and extraordinary services rendered by production workers, permanent and temporal that work in the establishment. It includes: Christmas bonuses, sales commissions, vacation benefits, bonuses, incentives and productivity bonuses.

- **Salaries Paid to Technicians(production)**

Is the total amount of all the money payments, payment for normal and extraordinary services rendered by production technicians, permanent and temporal that work in the establishment. It includes: Christmas bonuses, sales commissions, vacation benefits, bonuses, incentives and productivity bonuses.

- **Salaries Paid to Administrative Employees**

Is the total amount of all the money payments, payment for normal and extraordinary services rendered by production administrative employees, permanent and temporal that work at the establishment. It includes: Christmas bonuses, sales commissions, vacation benefits, bonuses, incentives and productivity bonuses.

- **Social Benefits**

Are the contractual and extra contractual payments, paid by the establishment to the employees, as an additional remuneration to the wages and salaries, paid in money or in kind. It

includes private medical services, pantry, insurance bonuses, educational services, educational help and day care; also profit redistributed back to the employees and workers compensation and liquidation.

- **Management Contributions to Social Security**

Is the total amount of all the money payments that are done based on the concepts of management quotas, Social Security (IMSS), Social Housing (INFONAVIT) and the Social Retirement Fund (SAR).

- **Man-Hours and Days Worked**

It is the number of normal and extraordinary hours labored by the workers (production), technicians (production), and administrative employees, as well as the effective days worked.

- **Worker(production)- Hours Worked**

It is the number of normal and extraordinary hours labored by the workers (production), man and women, by permanent and temporal that work in the establishment.

- **Technician(production)- Hours Worked**

It is the number of normal and extraordinary hours labored by the technicians (production), by permanent and temporal that work in the establishment.

- **Administrative Employees- Hours Worked**

It is the number of normal and extraordinary hours labored by the administrative employees (non- production), by permanent and temporal that work in the establishment.

- **Days Worked**

It is the total number of days worked by the establishment, without considering the number of days that work was suspended by any motive, Sundays, Holidays, strikes and stoppages.

- **Inputs Consumed**

The peso amounts of expenditures on the concepts of raw materials and auxiliaries, containers and packaging of imported or national origin. Consumed by the maquila process and received from abroad, from existing inventories or from other establishments as a transfer.

The value is assessed from the cost of purchase; the imported inputs are valued based on the entry prices that correspond with the registered value in the custom documents and the domestic inputs are valued with the prices registered in the sale documents.

In all cases transportation costs are considered that where laid out to transport the raw materials, containers and packaging to the production establishment.

- **Various Expenditures**

The peso amounts of expenditures realized by the establishment, in the purchase of goods and services destined to maintain the functioning of the productive process; it includes, the renting of machinery, equipment and transport in the country; renting of real estate; electricity energy consumption; communication services; third party services rendered to the establishment; customs arrangements for import and export; freights and cargo; repair and maintenance services of buildings, machinery, equipment and vehicles, etc.; fuel and lubricants consumed; water consumption; submaquila hiring; expenditures on the supply of personal and other expenditures not considered like technical and professional training, sports activities, paperwork, uniforms, etc.

- **Gross Profits**

The peso amount of the value of the gained profits by the establishment, that result of the difference between what is charge for the maquila service minus total expenditures realized, considering the income realized by submaquila services.

- **Export Value Added**

The peso amount of the value generated in the country by the export maquila process that for the maquiladora industry statistics comprehends: total salaries paid to the employees; raw materials; containers and packaging consumed of national origin; various expenditures and gross profits.

1.6 Data Management

Each establishment/plant is assigned a 10-digit identifier that is composed of the code numbers for the state, city, economic group and firm. This code allows to uniquely identify each establishment/plant through time. Every time a new establishment/plant is given authorization to operate as a maquiladora it is assigned the corresponding 10-digit code, based on what it produces. Correspondingly, every time a plant shuts down operations its identifier ceases to exist and it's never used again. This makes it possible to identify with a high degree of certainty the entry and exit of establishment/plants.

All variables presented in the EIME are in current nominal variables. In order to convert the variables into constant real variables the deflators from Banco de Mexico must be used. They are producer price indexes (PPI) that include: energy (electricity and fuel) price indexes, rent (equipment and non- residential buildings) price indexes and manufacturing industry sector price indexes. The base year for the producer indexes is December 2009. The series is available monthly from 1990-2006. The data was averaged by year to obtain the annual indexes. The price indexes are for final merchandises.

The zero observations in the data set are a result of the plant not reporting a value for a corresponding variable due to its inexistence for that category and weren't omitted by the plant (See Table 1). Another factor is that some information is only available from 1997-2006, like days worked, worker salaries classified by gender, and hours worked by type of employee that is not a worker. It is important to note that there is no other wage information by gender (See Table 1). Information on employment by gender is only available during the same period for the following classifications: technicians, administrative and all employees (See Table 1). In regard to gender classification by worker the series is available from 1990 to 2006 (See Table 1).

For the energy and rent indexes, there is no NAICS classification or manufacturing classification. The general overall index was used for energy and rent. The manufacturing price indexes are classified in nine manufacturing industries. The classification for the manufacturing price indexes are not NAICS, but are very similar to the three digit NAICS manufacturing industries from 311-399. The manufacturing classification for the producer price indexes aggregate various NAICS classification, thus one price index can be related to various NAICS industries or maquila economic groups. They were matched to the maquila and NAICS industry groups given the definition by Banco de Mexico of the nine manufacturing groups. All of these indexes were used to convert into real terms the following maquiladora variables: value added, consumption of inputs, consumption of electricity and fuel, the renting of machinery, equipment and transport in the country and the renting of real estate. The matching of the price indexes was collaborated in correspondence with the recommendations from Banco de Mexico´s Producer Price Index Department.

Table 1. Maquiladora Establishment/Plant Data Set Non-Zero Observations

Variable	Non-Zero Observations	Observations	%
Employees Workers Male	28,587	29,705	96.24
Employees Workers Female	25,927	29,705	87.28
Employees Workers	29,056	29,705	97.82
Employees Technicians Male	16,503	19,452	84.84
Employees Technicians Female	12,450	19,452	64.00
Employees Technicians	25,723	29,705	86.59
Employees Administrative Male	17,083	19,452	87.82
Employees Administrative Female	17,439	19,452	89.65
Employees Administrative	28,272	29,705	95.18
Employees Male	19,381	19,452	99.63
Employees Female	18,796	19,452	96.63
Employees	29,705	29,705	100.00
Salaries Paid Male Workers	18,747	19,452	96.38
Salaries Paid Female Workers	17,042	19,452	87.61
Salaries Paid Workers	29,063	29,705	97.84
Salaries Paid Technicians	25,710	29,705	86.55
Salaries Paid Administrative	28,245	29,705	95.09
Social Benefits	27,416	29,705	92.29
Social Security	18,828	29,705	63.38
Salaries Paid Employees	29,704	29,705	100.00
Worker Male-Hours Worked	18,760	19,452	96.44
Worker Female-Hours Worked	17,056	19,452	87.68
Worker -Hours Worked	29,064	29,705	97.84
Technicians -Hours Worked	16,777	19,452	86.25
Administrative -Hours Worked	18,577	19,452	95.50
Employees -Hours Worked	19,452	19,452	100.00
Days Worked	19,452	19,452	100.00
Raw Materials Imported	26,590	29,705	89.51
Packaging Imported	13,348	29,705	44.94
Inputs Consumed Imported	26,759	29,705	90.08
Raw Materials Domestic	15,078	29,705	50.76
Packaging Domestic	12,394	29,705	41.72
Inputs Consumed Domestic	18,254	29,705	61.45
Inputs Consumed	28,006	29,705	94.28
Renting Equipment Domestic	12,338	29,705	41.54
Renting of Real Estate	22,143	29,705	74.54
Electric Energy Consumption	27,728	29,705	93.34
Communication Services	27,769	29,705	93.48
Third Party Professional Services	26,753	29,705	90.06
Customs Arrangements	26,430	29,705	88.97
Freight and Cargo	22,416	29,705	75.46
Repair and Maintanence	26,970	29,705	90.79
Fuel Consumed	15,944	29,705	53.67
Water Consumption	16,276	29,705	54.79
Other Expenditures	27,948	29,705	94.09
Various Expenditures	29,540	29,705	99.44
Gross Profit	25,113	29,705	84.54
Export Value Added	29,705	29,705	100.00

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).

If observations=29,705 the series is from 1990-2006 vs observations = 19,452 the series is from 1997-2006.

To transform nominal peso variables into nominal dollars values Banco de Mexico´s fix exchange rate was used. In order to convert the nominal peso variables into real foreign values the real exchange rate index from Banco de Mexico was utilized. It is available monthly from 1990-2006. The data was averaged by year to obtain the annual indexes. Also, real exchange rates with 3–digit NAICS industry classification from the Federal Reserve Board of Governors were used. As well as the real exchange rate between Mexico and China by country from the Federal Reserve Board of Governors was used.

There is no information on capital equipment at the plant level for the maquiladora industry. Thus, a series of capital proxy variables were estimated. To do so, the renting of machinery, equipment and transport in the country and the renting of real estate in real terms were added to measure domestic capital expenditures. The estimated variable served as an approximation to the amount of capital at each plant, given the relationship between capital to its expenditures. In order to estimate capital intensity, domestic capital expenditures were divided by sales (export value added plus foreign inputs consumed) or by total hours worked (or total employment). Profit was also divided by hours worked (or total employment) to be used as a proxy for capital intensity.

In order to verify the accuracy of the information a set of estimates were ran to confirm the correctness of the data:

- Employees equal workers (production) plus technicians (production) plus administrative employees.

- Salaries Paid to Employees equals Salaries Paid to Workers (production) plus Salaries Paid to Technicians (production) plus Salaries Paid to Administrative Employees plus Social Benefits plus Management Contributions to Social Security.

- Inputs Consumed equals imported plus domestic

- Various Expenditures is equal to the sum of the individual expenditures.

- Export value added is equal to the sum of total salaries paid to the employees; raw materials; containers and packaging consumed of national origin; various expenditures and gross profits.

None of the identity checks by plant were found to be incorrect. All the variables were found to equal the sums of their components.

1.6.1 Non-Maquila Data Management

The information from the Center for International Data at U.C. Davis was utilized on exports and imports by industry and country to calculate import penetration in the U.S... The information is provided in 6-digit NAICS classification. The data was then aggregated to 3- digit NAICS. The merchandise import data can be estimated under two different classifications: general imports and imports for consumption. The first one is defined as imports as they come off the dock and they represent the total arrival of merchandise from foreign countries that immediately enter consumption channels, bonded warehouses, or foreign trade zones. The latter, imports for consumption, are combinations of entries for immediate consumption, including those coming from U.S. foreign trade zones and withdrawals from warehouses for consumption. As would be expected general imports are higher than imports for consumption. When

estimating the import penetration variables the values are similar for both general and consumption imports. The export data only includes domestic exports and excludes re-exports of foreign goods that are passing through the United States. Output information is provided by the Bureau of Economic Analysis (BEA) in 3-digit NACIS format.

Information on calculated duties, dutiable value and custom values from the United States International Trade Commission (ITC) was employed to estimate actual applied tariffs. The information is available by 3-digit NAICS and by country, in this case for China and Mexico, from 1997-2006. The data is used to measure the degree of accessibility to the U.S. market by each country, allowing for greater or lesser import penetration of their manufactured exports.

1.7 Aggregate and Plant Level Data Set Description

The number of maquiladora establishments included in the data set registers a steady increase from 1990 until the year 2001 (See Table 2). The number of plants increased from 1,256 to 2,241 during the period. After 2001, the number of establishments falls to stay approximately around 1,800 plants annually (See Table 2). A great number of the maquiladora establishments are concentrated in the electronic and electric materials and accessories industry (See Table 3). The majority of the maquiladora plants are located in the two border cities of Tijuana and Cd. Juarez (See Table 4).

The same tendency is observed in the number of employees and in the export value variables during the 1990 to 2006 period (See Table 2). One observes an increase and later a fall around 2001 for both variables. Although for the export value the decrease is a year later in

2002. The difference in the inflection point is due to the peso/dollar exchange rate as the exchange rate depreciated in 2002 in addition to the fall in employment that affected salaries. Also, the export value registers an important increase after the drop in 2002 until the year 2006 (See Table 2). Two industries stand out for the number of employees and the export value generated, one is the electronic and electric materials and accessories industry and the other one is the transportation manufacturing industry (See Table 3). These two industries are considered the main maquiladora industries in Mexico. The majority of the maquiladora employment and the export value are generated in the border cities of Tijuana and Cd. Juarez (See Table 4). Since the start of the Maquiladora program both cities have been a primary location for maquiladora operations.

When observing the data at the plant level by year, the average plant registers a consistent increase in the export value generated in dollar terms from 1990 to 2006 (See Table 5). This pattern is also true for domestic capital expenditures, as the average plants dollar capital expenditures - the renting of machinery, equipment and transport plus the renting of real estate - increased consistently during the same period (See Table 5). The number of employees working at an average plant increased from 1990-2000 (See Table 5). In the following two years, for both 2001 and 2002, the average number of employees working at each plant decreases (See Table 5). Then again, the average number of employees in each plant increases until 2006. The number of employees is related to the size of the plant, thus average plant size increased from 283 employees in 1990 to 433 employees in 2006 (See Table 5). The size of the larger maquiladora plants increased from 8,522 employees to 15,162 during the same period (See Table 5). Other plant data shows the participation of technicians in the workforce increased from 1990-2006, while female worker participation decreased (See Table 5). The average wages paid to workers

Table 2. Maquiladora Industry Data Set by Year

Year	Plants	Employees	Export Value Added(US$)
1990	1,256	354,880	2,829,845
1991	1,354	365,517	3,320,821
1992	1,448	392,431	3,758,256
1993	1,530	411,205	4,219,506
1994	1,513	437,873	4,622,999
1995	1,512	476,045	3,845,860
1996	1,640	536,896	4,707,882
1997	1,739	626,785	6,362,835
1998	1,861	688,790	7,519,856
1999	2,004	759,498	9,288,158
2000	2,146	853,657	11,472,366
2001	2,241	794,793	12,645,766
2002	2,019	713,717	12,412,147
2003	1,853	704,079	11,933,936
2004	1,854	738,830	12,267,755
2005	1,872	767,682	13,674,951
2006	1,863	805,928	15,257,679

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).
Export value is in thousands of dollars.

Table 3. Maquiladora Industry Data Set by Industry 1990-2006

Industry	Plants	Employees	Export Value Added(US$)	Export Value Added(% of Industry Total)
Selection, preparation, packing, and canning of food	484	70,483	1,688,533	1.20%
Apparel and texitle knitting and sewing	3,612	625,318	6,829,768	4.87%
Footwear manufacturing and leather and hide tanning	441	91,523	932,589	0.67%
Furtinure and other wood and metal products assembly	4,187	608,130	8,686,071	6.20%
Chemical products	1,783	279,276	4,151,419	2.96%
Manufacturing, re-manufacturing and transportation(and accesories) equipment assembly	2,616	2,618,308	35,516,728	25.34%
Assembly and repair of tools, equipment and parts, except electrical	718	176,524	2,928,989	2.09%
Assembly of machinery and equipment electrical and electronic devices	1,809	1,094,364	14,859,996	10.60%
Electronic and electric materials and accesories	6,344	2,990,281	40,029,466	28.56%
Sporting goods and toy assembly	462	135,488	1,569,490	1.12%
Other manufacturing industries	5,092	1,310,432	17,791,023	12.70%
Services	2,157	428,480	5,156,546	3.68%

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).
Export value is in thousands of dollars.

Table 4. Maquiladora Industry Data Set by City 1990-2006

State	Municipality	Location	Plants	Employees	Export Value Added(US$)	Export Value Added(% of Industry Total)
Baja California	Mexicali	Border	2,450	682,961	10,544,744	7.52%
	Tecate	Border	1,669	138,705	1,601,665	1.14%
	Tijuana	Border	9,863	2,100,452	27,511,979	19.63%
Coahuila	Acuña	Border	765	453,217	3,745,054	2.67%
	Piedras	Border	570	177,836	1,601,756	1.14%
	Torreon	Non-Border	635	240,562	3,093,183	2.21%
Chihuahua	Chihuahua	Non-Border	1,115	595,766	9,809,478	7.00%
	Juarez	Border	4,696	3,044,417	39,772,664	28.38%
Jalisco	Guadalajara	Non-Border	858	116,878	3,607,579	2.57%
Edo. de Mexico and Mexico City		Non-Border	417	47,987	730,436	0.52%
Nuevo León	Guadalupe	Non-Border	370	189,125	3,279,425	2.34%
	Monterrey	Non-Border	241	41,807	595,091	0.42%
Sonora	Agua Prieta	Border	434	116,935	884,795	0.63%
	Nogales	Border	1,292	460,232	5,547,777	3.96%
Tamualipas	Matamoros	Border	1,848	795,228	9,811,417	7.00%
	Nuevo Laredo	Border	736	310,928	5,003,930	3.57%
	Reynosa	Border	1,746	915,569	12,999,645	9.28%

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).
Export value is in thousands of dollars. Edo. de Mexico and Mexico City are added, given INEGI information presentation.

Table 5. Maquiladora Establishment/Plant Data Set by Year

Variable		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Value Added	Mean	2,253	2,453	2,595	2,758	3,056	2,544	2,871	3,659	4,041	4,635	5,346	5,643	6,148	6,440	6,617	7,305	8,190
	S.D.	4,950	5,621	6,238	6,918	7,355	5,691	6,470	8,142	9,334	10,589	12,751	13,999	15,917	15,465	15,214	16,305	18,154
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	56,778	67,439	76,548	100,785	88,925	95,044	80,110	109,176	114,040	157,477	189,220	210,160	283,090	239,411	248,503	259,173	294,207
Capital Expenditures	Mean	65	69	73	80	90	106	114	136	142	157	173	186	208	234	250	267	291
	S.D.	134	156	147	159	179	269	242	292	297	331	354	395	429	518	529	543	560
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	1,337	2,589	1,895	2,177	2,552	5,562	2,810	2,979	3,087	4,587	4,390	5,147	5,612	7,480	7,788	8,207	7,269
Employees	Mean	283	270	271	269	289	315	327	360	370	379	398	355	354	380	399	410	433
	S.D.	599	598	616	629	650	675	724	789	820	836	914	849	872	872	865	894	897
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	8,522	8,406	8,800	9,229	9,238	7,511	8,100	10,423	13,195	12,110	17,754	18,030	17,634	15,805	13,825	15,424	15,162
Technicians/Total Employees	Mean	0.10	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.13	0.13
	S.D.	0.09	0.10	0.10	0.10	0.10	0.09	0.09	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.14
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	1.00	1.00	1.00	1.00	1.00	0.83	0.81	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Female Worker Participation	Mean	0.50	0.50	0.50	0.49	0.49	0.49	0.48	0.47	0.46	0.45	0.45	0.45	0.45	0.44	0.45	0.44	0.44
	S.D.	0.31	0.31	0.31	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.27	0.28	0.28	0.28	0.28
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wages/Salaries per Worker	Mean	0.91	1.01	1.12	1.23	1.22	0.78	0.80	1.02	1.05	1.20	1.34	2.40	2.95	1.70	1.75	1.90	1.98
	S.D.	0.37	0.44	0.50	0.53	0.51	0.33	0.30	0.40	0.42	1.71	0.59	5.59	6.69	0.84	0.96	1.01	0.87
	Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Max	3.45	5.05	6.02	5.96	5.50	5.98	3.29	3.48	5.34	74.16	8.89	55.76	53.96	10.64	15.51	21.52	10.09

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).

Export Value Added and Capital Expenditures is in thousands of dollars.

Export value added equals the sum of total salaries paid to the employees; raw materials; containers and packaging consumed of national origin; various expenditures and gross profits.

Domestic capital expenditures equals the sum of the renting of machinery, equipment and transport plus the renting of real estate divided by total workers.

Female Worker Participation equals female workers divided by total workers.

Wages/ Salaries per Worker equals the division of total salaries and wages paid to workers in dollars divided by the number of workers.

The official nominal exchange rate pesos per dollar published by Banco de Mexico was used to convert the figures into dollars.

Table 6 . Maquiladora Establishment/Plant Data Employment Distribution 1990-2006

Employees	# Plants
>0-1	270
1-10	3,213
11-20	2,398
21-30	1,897
31-40	1,625
41-50	1,317
51-60	1,150
61-70	963
71-80	798
81-90	743
91-100	704
101-200	4,377
201-300	2,368
301-400	1,429
401-500	1,101
501-1000	2,824
1001-1500	1,015
1501-2000	567
2001-3000	512
3001-4000	172
4001-5000	107
5001-6000	63
6001-7000	35
7001-8000	17
8001-9000	9
9001-10000	7
10001-15000	18
15000-18030	6
Total	29,705

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).

in dollar terms increased from $.91 in 1990 to $1.98 in 2006, reaching it highest value in 2002 of $2.95 (See Table 5). The maximum values reported for wages per worker are high because in a few cases firms reported values greater than zero but less than or equal to 2 workers so when dividing the salaries paid by workers by the number of employees the value came out well above the average. The reason for the fraction values in the number of employees is caused by the annual estimation of the information from monthly data, so if a company reported zero employees during various months with one or two employees in a few months this would give you a fractional annual value for the number of employees (See Table 6).

For the plant level data when comparing the variables by industry there are three industries that on average by establishment register the highest export value, domestic capital expenditures and employment (See Table 7). These three industries are: the transportation manufacturing industry; electronic and electric materials and accessories industry; and the assembly of electronic and electric machinery and equipment industry (See Table 7). The transportation manufacturing industry is one of the industries that has a high ratio of technician employees and also pays on average one of the highest wages per worker (See Table 7). This is also true for the industry that assembles and repairs tools and equipment that are not electrical, registering the highest ratio of technicians and the highest wage per worker (See Table 7). The electronic and electric materials and accessories industry also registers a high ratio of technicians and one of the highest wages per worker (See Table 7). The furniture industry is the other one that registers a high wage per worker (See Table 7). The industries with the highest participation of women are: apparel, the assembly of electronic and electric machinery and equipment industry, and sporting goods and toy assembly (See Table 7).

Table 7. Maquiladora Establishment/Plant Data Set by Industry 1990-2006

Variable		Selection, preparation, packing, and canning of food	Apparel and textile knitting and sewing	Footwear manufacturing and leather and hide tanning	Furniture and other wood and metal products assembly	Chemical products	Manufacturing, re-manufacturing and transportation(and accessories) equipment assembly	Assembly and repair of tools, equipment and parts, except electrical	Assembly of machinery and equipment electrical and electronic devices	Electronic and electric materials and accessories	Sporting goods and toy assembly	Other manufacturing industries	Services
Value Added	Mean	3,489	1,891	2,115	2,075	2,328	13,577	4,079	8,214	6,310	3,397	3,494	2,391
	S.D.	7,804	6,717	3,838	4,227	3,963	26,661	9,835	14,218	12,882	6,947	6,670	5,019
	Min	0	0	0	0	0	0	0	0	0	0	0	0
	Max	64,491	143,572	34,846	52,152	50,938	294,207	176,361	198,011	228,685	41,898	101,026	88,990
Capital Expenditures	Mean	93	56	89	115	130	320	164	243	191	197	169	136
	S.D.	267	122	216	296	230	666	298	472	391	356	354	299
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Max	2,123	1,463	1,964	5,352	2,011	8,207	2,300	5,612	5,037	2,580	3,635	4,964
Employees	Mean	146	173	208	145	157	1,001	246	605	471	293	257	199
	S.D.	221	379	285	280	248	1,907	457	906	726	574	444	400
	Min	0	0	0	0	0	0	0	0	0	0	0	0
	Max	1,905	3,734	2,227	3,467	2,535	18,030	4,325	9,238	6,513	3,486	5,967	3,974
Technicians/Total Employees	Mean	0.12	0.09	0.10	0.10	0.13	0.13	0.14	0.13	0.13	0.09	0.11	0.11
	S.D.	0.16	0.09	0.10	0.11	0.12	0.10	0.15	0.09	0.11	0.09	0.11	0.17
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Max	1.00	1.00	0.57	1.00	1.00	0.86	1.00	0.94	1.00	0.86	0.96	1.00
Female Worker Participation	Mean	0.41	0.65	0.42	0.21	0.42	0.39	0.27	0.55	0.61	0.56	0.45	0.40
	S.D.	0.28	0.21	0.28	0.23	0.27	0.28	0.28	0.25	0.23	0.24	0.27	0.32
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wages/Salaries per Worker	Mean	1.50	1.17	1.30	1.50	1.42	1.68	1.74	1.45	1.49	1.42	1.49	1.84
	S.D.	3.14	2.19	1.03	1.99	1.87	2.88	0.98	1.55	2.85	2.97	2.56	3.41
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Max	44.72	42.72	13.70	44.72	44.72	74.16	6.93	43.20	55.76	44.72	46.45	48.41

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).

Export Value Added and Capital Expenditures is in thousands of dollars.

Export value added equals the sum of total salaries paid to the employees; raw materials; containers and packaging consumed of national origin; various expenditures and gross profits.

Domestic capital expenditures equals the sum of the renting of machinery, equipment and transport plus the renting of real estate divided by total workers.

Female Worker Participation equals female workers divided by total workers.

Wages/ Salaries per Worker equals the division of total salaries and wages paid to workers in dollars divided by the number of workers.

The official nominal exchange rate pesos per dollar published by Banco de Mexico was used to convert the figures into dollars.

Table 8. Maquiladora Establishment/Plant Data Set by City 1990-2006

Variable		Mexicali	Tecate	Tijuana	Acuña	Piedras	Torreon	Chihuahua	Juarez	Guadalajara	Edo. de Mexico and Mexico City	Guadalupe	Monterrey	Agua Prieta	Nogales	Matamoros	Nuevo Laredo	Reynosa
Value Added	Mean	4,304	960	2,789	4,895	2,810	4,871	8,798	8,469	4,205	1,752	8,863	2,469	2,039	4,294	5,309	6,799	7,445
	S.D.	8,627	3,212	6,750	11,557	5,572	9,354	16,737	19,486	12,798	2,859	20,911	5,179	3,780	8,854	11,035	11,804	15,930
	Min	0	0	0	0	0	0	0	0	0	0	0	0					
	Max	98,387	52,152	180,528	105,867	46,695	69,155	186,843	294,207	143,572	19,283	198,011	36,212	26,237	112,159	111,771	85,027	187,147
Capital Expenditures	Mean	198	56	140	171	155	99	228	247	75	58	248	43	84	187	115	245	189
	S.D.	375	169	305	416	286	279	534	505	177	104	574	94	289	328	246	627	423
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
	Max	4,587	2,082	5,612	3,747	2,059	2,398	7,480	7,788	1,413	628	4,390	746	2,962	3,545	2,580	8,207	5,562
Employees	Mean	279	83	213	592	312	379	534	648	136	115	511	173	269	356	430	422	524
	S.D.	451	208	452	1,324	615	823	986	1,306	219	200	856	393	480	604	775	645	1,025
	Min	0	0	0	0	0	0	0	0	0	0	0	0					
	Max	3,486	2,541	7,505	11,758	4,570	8,735	8,349	18,030	2,024	1,331	4,411	2,559	3,653	5,050	5,883	4,889	9,238
Technicians/Total Employees	Mean	0.13	0.10	0.10	0.12	0.11	0.11	0.13	0.13	0.11	0.10	0.13	0.09	0.14	0.13	0.12	0.15	0.13
	S.D.	0.11	0.10	0.11	0.10	0.08	0.13	0.13	0.11	0.15	0.14	0.16	0.15	0.10	0.10	0.11	0.13	0.12
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
	Max	1.00	0.85	1.00	0.61	0.41	0.82	1.00	1.00	1.00	1.00	0.85	1.00	0.70	1.00	0.89	0.89	0.96
Female Worker Participation	Mean	0.52	0.43	0.43	0.40	0.50	0.50	0.56	0.46	0.50	0.59	0.55	0.57	0.50	0.45	0.52	0.43	0.47
	S.D.	0.33	0.30	0.29	0.26	0.25	0.32	0.31	0.24	0.33	0.32	0.32	0.32	0.25	0.21	0.33	0.33	0.27
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
	Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wages/Salaries per Worker	Mean	1.57	1.33	1.52	1.43	1.04	1.10	1.65	1.39	1.98	1.54	1.57	1.67	1.12	1.42	1.74	1.50	1.43
	S.D.	1.99	2.16	2.41	3.06	1.12	0.71	2.76	2.37	5.32	4.43	3.31	3.69	2.73	1.68	2.16	2.41	2.35
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
	Max	48.41	53.96	55.76	46.45	25.22	7.90	41.40	55.76	48.80	74.16	44.72	38.78	55.76	38.78	53.86	44.72	44.97

Source: Estimated with information from the Instituto Nacional Estadística y Geografía(INEGI).

Export Value Added and Capital Expenditures is in thousands of dollars.

Export value added equals the sum of total salaries paid to the employees; raw materials; containers and packaging consumed of national origin; various expenditures and gross profits.

Domestic capital expenditures equals the sum of the renting of machinery, equipment and transport plus the renting of real estate divided by total workers.

Female Worker Participation equals female workers divided by total workers.

Wages/ Salaries per Worker equals the division of total salaries and wages paid to workers in dollars divided by the number of workers.

The official nominal exchange rate pesos per dollar published by Banco de Mexico was used to convert the figures into dollars.

The information by city at the plant level shows that the average establishment located in Guadalupe, Chihuahua and Juarez registered the highest export value added and capital expenditures (See Table 8). In regard to the number of employees, on average plants located in Juarez, Acuña and Chihuahua registered the biggest employee size (See Table 8). The ratio of technicians to total employees was highest for the average plant located in Chihuahua, Juarez and Mexicali (See Table 8). For the ratio of females workers to total workers the plant average for Mexico City – that includes Edo de Mexico-, Monterrey and Guadalupe was one of the highest (See Table 8). The average salary per worker was highest in the plants located in Guadalajara, Monterrey and Chihuahua (See Table 8).

1.8 Conclusion

In this paper a detailed description of the Mexican Maquiladora Industry information is presented that will be used in succeeding empirical research. The maquiladora plant level information offers a very valuable dataset to analyze the behavior and evolution of the Mexican Maquiladora Industry an Export Oriented Industry.

CHAPTER II

THE IMPACT OF CHINESE COMPETITION ON MEXICAN MAQUILADORAS: EVIDENCE FROM PLANT-LEVEL DATA

Co-Authored with Hale Utar[1]

2.1 Introduction

China's size, rapid economic growth and trade performance is being felt everywhere. Especially so in Mexico which has been a main competitor of China in the United States markets for manufactured products. This competition saw a major shift in favor of China with China's 2001 accession to the World Trade Organization (WTO). By 2003 China had surpassed Mexico as the second most important import supplier to the Unites States, behind Canada.

China's accelerated trade growth due to lower trade costs in the wake of WTO accession provides us with a natural experiment to analyze the impact of international competition in general. Similarity in export baskets between Chinese and Mexican manufacturers to the US market makes the competition between Mexico and China even more intense, and the analysis more revealing.

We explore here what China's export growth means for exporters in Mexico, particularly for the Mexican maquiladoras. Maquiladoras are export assembly plants historically specialized in labor- intensive products such as apparel, footwear, electronics and toys. Long before The North American Free Trade Agreement (NAFTA), favorable duty regulations with the United States have been in place for maquiladoras since 1965. Since then, close proximity to the US market and relatively cheap labor made Mexico one of the most favorable offshoring destination for US companies for a long time. In 2006 the Maquiladora industry in Mexico generated more

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than 24 billion dollars in foreign exchange, and accounted for 44 percent of total Mexican manufacturing exports.

The impact of China's trade is an important policy question and has recently also received academic attention. Hanson and Robertson (2008) estimate the impact of increase in manufacturing export from China on the demand for export from 10 other developing countries covering the period between 1995-2005. Based on gravity equation estimates they conclude that the impact is small. Bloom et al. (2009) use a panel of establishments from European countries to test the impact of Chinese imports on the use of Information Technology equipment and innovation, finding a positive association between the two.

In this paper, we investigate the impact of the competition from China on Mexican export assembly plants (maquiladoras); on plants' growth, entry, exit and productivity using plant-level panel data that covers the universe of Mexican maquiladoras. The data we use covers the years 1990-2006, a time period long enough that it allows properly identifying the effects, if any, of Chinese competition. Our sample starts in 1990 where China's share in manufacturing trade in the World was 1.74 % and covers until 2006 where China's share became 8.37 % (World Bank).

In contrast to previous studies on the Chinese competition we are better able to isolate the competition effect from the dual, even triple, effects of Chinese trade: China as an export market, China as a partner and China as a competitor. We focus entirely on export assembly plants in Mexico that are tied to the US manufacturing sector where we expect direct competition between Mexican and Chinese plants, also because they have similar export baskets in the US market.

This paper provides a first analysis of any aspect of Mexican Maquiladoras using plant level panel data. In addition, we examine the link between international competition and

productivity using the WTO accession of China as a quasi-natural experiment which allows us to identify the impact of intensified competition on the productivity of Mexican plants.

We find partial evidence supporting the frequently stated view by Mexican policy makers that Chinese competition is forcing maquiladoras to exit low-tech, labor intensive industries and evolve toward higher value added, technology intensive sectors.

We find strong evidence for within plant productivity improvement of maquiladoras due to heightened competition from China. We also find that although the number of entrants decreases with intensified Chinese competition, plants enter with a higher level of productivity as competition intensifies. But we do not find that intensified competition from China improves the productivity of maquiladoras by causing exit of low-productivity plants.

Plant's employment growth is also found to be negatively affected by Chinese competition. More specifically, a one standard deviation increase in China's share of the import penetration rate is found to be associated with a decrease in annual plant employment growth of 6.2 percentage points.

Our results lend support to a commonly held view among Maquiladora managers: "By moving up the technological ladder, companies say they can afford to pay the relatively high salaries common along the Mexican border and not relocate to lower-wage countries." (Lindquist (2004))

Both China and Mexico liberalized their economies since 1980s and hope to gain through increasing openness. Although trade growth was impressive in both countries in the last decades, China's trade growth was also fueled by productivity-based economic growth; whereas Mexico

experienced relatively un-impressive economic growth performance. Despite official Mexican concerns regarding China's accession to WTO, our work highlights that long expected productivity growth in Mexico due to export and FDI may have just begun, ironically, triggered by competition from China.

In the next section we describe the environment of maquiladora industry and the data used. In section 3, we sketch some theoretical models. In section 4 our empirical model is outlined, and results are interpreted in section 5 followed by conclusions.

2. 2 Data Overview

2.2.1 Mexican Maquiladoras

Maquiladora plants are offshoring plants. A typical maquiladora plant imports inputs mostly from the United States, processes them, and then ships them back to the country of origin. The maquiladora program started in the mid-60s; it permits tariff-free transaction of the inputs and the machinery between 'a maquiladora plant' and the foreign companies[2]. Upon the return of the goods, the shipper pays duties only on the value added by manufacture in Mexico (Gruben (2001)).[3]

In general, there are three ways in which a maquiladora can operate: subcontracting, shelter operation and direct ownership. The subcontracting operation offers the least amount of control to the foreign firms, given that the subcontractor fulfills all of the manufacturing operations according to an arrangement established with the foreign firm. Shelter operations offer more control, especially in the production process, but not in the administrative operation of the maquiladora plant, i.e. legal, accounting, customs, etc. Direct ownership offers the foreign

[2] In order to benefit from the maquiladora program, a plant has to be registered as a maquiladora plant.
[3] Export Processing Zones (EPZ) are similar to the maquila program of Mexico, and can be found around the world.

firm the most control and supervision over manufacturing operations. Since its introduction, the maquiladora industry moved from consisting of only low-skilled labor intensive plants, like apparel manufacturing, to more advanced manufacturing processes, like electronics, electrical appliances and automotive. The government allowed the establishment of maquiladoras in the interior regions of Mexico. NAFTA also contributed to maquiladoras being allowed to sell their output domestically. However, this option is rarely exercised.

The implementation of NAFTA required Mexico to change certain provisions for the maquiladora industry, such as the elimination of certain tariff benefits. Most importantly, on January of 2001, duty-free imports from non-NAFTA countries were eliminated because these countries intended to subsequently re export to another NAFTA country. These changes were based on the rules of origin that were established under the treaty, where goods traded between NAFTA countries are allowed duty free treatment only when the goods satisfy a minimum percentage of North American content. Due to complaints from leaders of the maquiladora industry, the Mexican government revised its regulations of the maquiladora sectors and created a sectoral promotion program to protect the duty-free status of maquiladora imports and therefore, allowing the maquiladora program to continue non-NAFTA content imports. Even after 2001 there is no incentive for a foreign company not to register as being a maquiladora if it is part of a foreign chain of production re-exporting its goods to the US. This is due to the tax provision (APA) that allows maquiladoras not to pay income taxes in the same way as the domestic manufacturing industry (Truett and Truett (2007), Cañas and Coronado (2002)).

2.2.2 Plant-level Data

The maquiladora industry data is from INEGI (Instituto Nacional Estadstica y Geografia). INEGI has conducted an annual survey of the universe of plants registered under the maquiladora program until 2007.[4] The observation unit for the industry is a maquiladora establishment, or plant. The data contains firm id's as well as plant id's so that it is possible to identify multi-plant and single-plant firms. The data set used for the present study is an annual panel data set which covers the period between 1990-2006 for eleven manufacturing maquiladora industries. The survey covers the universe of export assembly plants (maquiladoras) in Mexico. The majority of the plants are owned by US companies. We do not have ownership data at the plant-level due to confidentiality issues, but we do have aggregate capital investment data in maquiladora industry which can be used as an ownership proxy. In 1994, the US share of capital equipment investment was 92.4 %. The next biggest investor was Japan, with a share of 2.5 %. In 2006 the US's share was 88.1 % followed by Canada and Switzerland both having 1.4 % share (Source: Secretaria de Economía). In terms of sales, maquiladoras' export to the US was 99.7 % of the total maquiladora export in 1993. In 2006 94 % of the total maquiladora sales were to the US followed by Canada with a share of 1.7 % (Source: INEGI). INEGI dropped establishments which did not answer the questionnaire or did not report one of the output measures from the data set[5]. Thus, the final data set consist of 27,548 plant year observations that consist of 3,769 plants and 1,455 firms (1655 plants on average per year). For each plant we have

[4] In 2007 a regulatory change was enacted that merges the maquiladora program with an export oriented program for domestic companies known as the Program for Temporary Imports to Promote Exports (PITEX). The new program is called Maquiladora Manufacturing Industry and Export Services (IMMEX). As a result, INEGI stopped reporting maquiladora data after March 2007 and the data has been merged in to the IMMEX data.

[5] Every plant operating under the maquiladora program was legally required to answer the questionnaire. Our data set reveals that plants which did not answer the questionnaire (although legally required) are mostly located in the interior regions of Mexico where maquiladora concentration is very little. Further characterization of non-responsive and removed plants is being pursued in correspondence with INEGI.

information on hours worked and the number of employees by job category, wages paid by job category as well as plant expenditures/inputs, export sales, and value-added. We do not have information on the owned capital, but plants report rental expenditures on different capital items. All the nominal values are expressed in 2002 Mexican peso. See Table 1 for the descriptive statistics. We use separate industry deflators (industry classification for deflators approximately corresponds to 3-digit SICs) for each maquiladora sector to deflate revenues and material expenditures. We use energy deflators to deflate fuel and electricity; a machinery rental deflator to deflate the rental expenditures in machinery and equipment and a building rental deflator to deflate the building rental expenditures. The deflators are provided by Banco de Mexico. In the data-set we have 11 sectors, which we match with the corresponding US industries in order to construct our aggregate variables. Table 1A presents these 11 industries and corresponding NAICS codes.

2.3 Theoretical Motivation

China and Mexico are the two main offshoring destinations for the US manufacturing sector. We expect that China's recent trade performance accompanied by its accession to WTO has direct and strong effect on Mexican export assembly plants.

2.3.1 Heckscher-Ohlin Theory

Both China and Mexico have a comparative advantage in labor-intensive products compared to the US. However, China has a comparative advantage in unskilled labor in comparison to Mexico. In 1999, approximately 13 % of the Latin American population has post-secondary education, compared to 3 % in China (Devlin, Estevadeordal and Rodriguez-Clare (2006)). Factor content theory suggests that as trade liberalizes in China, industries that disproportionately employ unskilled workers will shrink in Mexico and the opposite will occur in

Table 1: Descriptive Statistics of the Plant Level Data Set

	Mean	Standard Deviation	Median	Observation
Labor (total hours)	769179.1	1744475	219399	27548
Production Workers	288	658.3	82	27548
Non-Production Workers	75	186.4	16.6	27548
Materials	187436	724008.8	16754.2	27548
Capital	1763.2	3965.8	363.5	27548
Value Added	50703.3	123993.4	12581	27548
Gross Output	242820.8	818301.6	31962.5	27548

Note: Values are expressed in thousand 2002 Mexican peso.

Table 1A Maquila Industry Descriptions

Description	NAICS Code
Selection, preparation, packing, and canning of food	3114
Apparel and texitle knitting and sewing	3151,3152,3159,3169
Footwear manufacturing and leather and hide tanning	3161,3162
Furtinure and other wood and metal products assembly	3323,3371,3379
Chemical products	33251,3252,3253,3254,3255,3256
Manufacturing, re-manufacturing and transportation(and	3362,3363,3369
Assembly and repair of tools, equipment and parts, except	3331,3332,3334,3339
Assembly of machinery and equipment electrical and	3341,3342,3343,3344,3345,3346,3352
Electronic and electric materials and accesories	3351,3353,3359
Sporting goods and toy assembly	3339920,339931,339932
Other manufacturing industries	334510,3391,3399,339992*
Services	541380, 561990, 5621, 2622, 5629, 8123

Source: Department of Exterior Commercial Statistics, Administrive and Pricing Registry, INEGI

*/Excluding 339920-339931-339932

China. This can happen through the intensive margin that export assembly plants operating in Mexico shrink. It can also happen through the extensive margin that plant exits occur as a result of the competition and or that heightened competition discourages entry of new plants.

2.3.2 Product market competition

Product market competition will lead Mexican plants to lose market share in the US market. Typical industrial organization theories with differentiated products (Dixit and Stiglitz (1977), Salop (1977)) predict a negative relationship between competition and innovation/ upgrading since competition will decrease the rents of innovating/upgrading for innovators upon innovation[6]. This is the Schumpeterian effect that the incentive to innovate decreases as competition increases. However, the innovation/upgrading decision is also affected by the difference between the pre-innovation and post-innovation rents (Aghion et al. (2005)). If the pre-innovation rent disproportionately decreases due to intensified competition, then firms upgrade or innovate to be able to survive or 'escape' from the competition as much as possible. It is shown in Aghion et al. (2005) that such an escape competition effect is stronger when the market structure is such that technological differences between firms are small. Export assembly industry both in China and Mexico are mostly based on labor intensive technologies with no large technological gaps between plants, so one may expect to see stronger escape competition effect on plants' incentive to upgrade their technologies.

Another possible channel that can strengthen the escape competition effect is through a parent-subsidiary relationship. Consider two competing offshoring destinations. In response to lower trade costs in one of the offshoring destinations, a parent with a subsidiary in another

[6] Arrow (1962) on the other hand shows that the incentive to do cost-reducing innovation is higher for a perfectly competitive firm than a monopolist in the homogeneous product markets under certain assumptions.

location would make a 'credible' threat of relocating the subsidiary and therefore increases the incentive for the manager of the subsidiary to put more efforts and decrease X-inefficiencies. Principal-agent problems are especially relevant to our context as we focus on the performances of subsidiaries. Papers analyze the competition and within firm productivity from a principal-agent problem perspective include Hart (1983), Scharfstein (1988), and Hermalin (1992) among others.[7]

One of the paper most relevant to our analysis is Horn et al. (1995). They study the design of an optimal incentive contract for managers and they find that by increasing the product market competition, international competition increases incentives for managers to decrease X-inefficiencies and thereby increases within firm productivity. The specific channel through which their conclusion is derived is the following: Intensified competition increases the demand elasticity's that firms face and therefore increases firms' incentive to produce more. As all firms want to expand, this increases demand for labor and increases real wages of production workers. The two effects, higher output and higher production wages, cause managers to supply more effort and use less input from production workers, and thus decrease X-inefficiencies in a world of incomplete contracts with unobservable efforts. We now turn to the empirical model.

2.4 Empirical Model

Since we are interested in quantifying the impact of competition between China and Mexican Maquiladoras for the US market, we construct our measure of Chinese competition for Maquiladoras as the Chinese share of the import penetration for the matched US industry, following Bernard, Jensen and

[7] In Hart (1983) and Scharfstein (1988), competition affects the informational structure and changes the possibilities that principal can make inferences about the manager's action. In Hermalin (1992) competition changes the manager's incentive through the income effect.

Schott (2006). That is, our measure of competition is the total Chinese imports coming to the matched US industry relative to consumption of the US industry products:[8]

$$IMPCH_{jt} = \text{————} \quad (1)$$

where, denotes the value of imports of industry j products coming from China to the US at period t. *M*, *Q* and *X* denote total US imports, US production and US exports respectively.

We also use import penetration rate without Chinese imports, defined below, as an aggregate control variable.

$$IMPC_{jt} = \text{————} \quad (2)$$

2.4.1 Employment Growth

We start with a basic regression to test the impact of Chinese competition on employment growth in Mexican Maquiladoras. Consider the following specification:

$$\Delta lnE_{ijst} = \alpha_0 + \alpha_1 X_{ijst} + \alpha_2 Z_{jt} + \alpha_3 IMPCH_{jt} + \alpha_4 IMPCH_{jt} * x_{ijst} + \sum_{ts} Year_t * State_s + \sum_j Industry_j + u_i + \in_{ijst} \quad (3)$$

where $\Delta lnE_{ijst} = lnE_{ijst+1} - lnE_{ijst}$ and E_{ijst} refers to total employment. Subscripts i,j,s, and t index plant, industry, state and year respectively. We allow for unobserved heterogeneity u_i which may be correlated with regressors and estimate equation 3 using OLS. We add interactive state-by-year fixed effects to control for aggregate shocks that may affect employment growth across all sectors but may vary across different states for example due to local labor market conditions. Additionally, we control for industry specific fixed factors that may affect plants'

[8] An alternative would be the ratio of total imports coming from China to the relevant US industry to total imports in the US industry as used in Bloom et al. (2009). We use both of them. The magnitudes of our results are not the same because of different choices of normalization, but they are qualitatively the same.

growth. Vector X includes time varying plant-level controls that are found to be important in determining firms' growth: these are size dummies, plant tfp, a multi-plant dummy, and age of a plant.[9] Vector Z includes time varying industry-wide controls; these are industry aggregate variables for the matched US industries that may affect the demand for a particular maquiladora sector: import-penetration rate of the corresponding US industry calculated without the imports from China, the matched US industry hourly wages relative to the corresponding measure in the Maquiladora sector, and the production index of the matched US industries to control for the sector specific business cycles.[10]

We then interact our Chinese competition measure with several variables of interests x_{ijst} (productivity, skill-intensity, capital-intensity); to see if trade between the US and China has a disproportionate effect on any particular type of export-assembly plants in Mexico.

There would be an endogeneity problem if unobserved factors that affect employment growth of maquiladoras also affect the Chinese share of import penetration in the US industry. Our industry level variables including the Chinese share are variables for the US industries not for Maquiladora industries and it is safe enough to assume that the US variables are exogenous from the perspective of Mexican maquiladoras. However, we still did a robustness check by instrumenting the Chinese share of import penetration rate, *IMPCH*, as well as import penetration rate with no Chinese imports, *IMP*, whenever applicable. We instrumented the Chinese share of import penetration rate with the real exchange rate between China and the US interacted with the 1999 Chinese share of import penetration of the corresponding US NAICS for

[9] We constructed 5 category of sizes in the ranges 1-50, 51-100, 101-500, 501-1000 and 1000+ dummies as measured by number of employee. We exclude the smallest size category from the regressions.
[10] Details of these data are given in the appendix.

each Maquiladora sector. Clearly the real exchange rate between China and the US must be exogenous from the perspective of Mexican plants. By interacting it with the cross-sectional shares before China's accession to the WTO, we get the cross-industry variation in the degree of Chinese comparative advantage. Another instrument we use is the worldwide Chinese imports (exports from China) interacted with the 1999 Chinese import shares over all imports of the corresponding US NAICS for each Maquiladora sector. In order to instrument the import penetration rate calculated without Chinese imports, *IMP*, we use the industry specific exchange rate for the US industry where the weights for each trading partner's currency are lagged share of imports of that particular trading partner. We also use lagged values of import-penetration rates constructed without Mexican imports as well as Chinese imports. Bloom et al. (2009) use a similar strategy in instrumenting their Chinese competition proxy. In contrast to Bloom et al. (2009), our Chinese competition proxy is not constructed by the imports measure of the same industry reducing endogeneity concerns even further.

2.4.2 Employment at the Extensive Margin

What happened to the attractiveness of Mexico as an offshoring destination as China started to become a favorable offshoring destination? In order to analyze the impact of Chinese competition on plant entry we aggregate the plant-level data to industry-level and estimate the following equation:

$$ln(ENTRY_{jt}+1) = \gamma_0 + \gamma_1 Z_{jt} + \gamma_2 IMPCH_{jt} + \sum_t Year_t + \sum_j Industry_j + \in_{jt} \quad (4)$$

$ENTRY_{jt}$ is the total number of entrants in industry j at period t. We include industry dummies to control for industry-specific factors that affect entry, such as different levels of sunk entry costs

associated with starting up, say, apparel versus auto parts assembly plants. We also include year dummies to control for aggregate shocks such as exchange rate fluctuations that may affect the entry decision. If intensified Chinese competition discourages entry of new export-assembly plants in Mexico, we expect γ_2 to be negative. We do not use the count data nature of our dependent variable in equation 4, since we use the transformation ln(1+y). We also estimate the entry equation without using the logarithmic transformation with Poisson and negative binomial regressions. Our dependent variable exhibits over-dispersion so we opted for the negative binomial model. In this specification our dependent variable conditional on our regressors assumed to be distributed with Negative Binomial distribution. It is a Poisson-like distribution but unlike Poisson, equi-dispersion (that is, mean equals variance $Var(y_i|x_i) = exp(x'_i\beta)$) is not imposed. Variance is assumed to be $Var(y_i|x_i) = exp(x'_i\beta)$) + α * ($exp(x'_i)2$ where α is an over-dispersion parameter, y is *ENTRY*, and x is our vector of regressors.

Another potential effect of intensified Chinese competition is to cause already existing plants to cease production and exit. We look at the impact of Chinese competition on maquiladora exit using a probit analysis,

$$\chi_{ijst} = \eta_0 + \eta_1 X_{ijst} + \eta_2 Z_{jt} + \eta_3 IMPCH_{jt} + \sum_j Industry_j + \sum_s State_s + \sum_t Year_t + \in_{ijst} \quad (5)$$

where χ_{ijst} is an indicator for exit decision that takes 1 if plant i ceases its operation next period.

2.4.3 Productivity

There are mixed empirical evidence whether competition would lead to upgrade of techniques (defensive innovation) or not. We constructed a difference in difference approach to investigate the impact of Chinese competition on the productivity of Mexican maquiladoras.

Our identification strategy is based on the fact that some of the maquiladora sectors which have only very little Chinese presence should not be affected by Chinese accession to WTO as much as sectors with heavy presence of Chinese imports. We constructed three groups, one, *MoreCHT* where we expect high degree of Chinese Threat, consisting of sectors with more than 6 percent average Chinese share of import-penetration rate at the US market. These are apparel, footwear and leather, electrical machinery and toys and sporting goods. Our second group, *NoCHT* where we expect minimum Chinese presence and threat, consists of sectors with less than 0.4 percent average Chinese share of import-penetration in the US market. These are Chemicals, Transportation (Auto Parts) and Food products. Our third group which is an excluded group in our regressions consists of furniture and wood products, metal products, computer and electronic accessories, and miscellaneous manufacturing. These are the sectors with medium presence of Chinese presence.[11] Although we base our classification on the import-penetration rate, sectors with tiny presence of Chinese imports are also reflecting the sectors in which Mexico has a comparative advantage due to transportation costs (food, transportation), relative skill-intensity (chemicals, transportation), and also due to the level of protection of the industries (chemicals, transportation).

[11] We use different thresholds to check the robustness of our results and find that our qualitative results are not sensitive to different thresholds.

We then construct our difference in difference estimator as follows:

$$lnTFP_{ijst} = \mu_0 + \mu_1 I(WTO) + \mu_2 I(MoreCHT) + \mu_3 I(MoreCHT) * I(WTO) + \mu_4 I(NoCHT) + \mu_5 I(NoCHT) * I(WTO) + \mu_5 I(WTO) + \mu_6 X_{ijst} + \sum_j Industry_j + \sum_s State_s + \sum_t Year_t + \in_{ijst} \quad (6)$$

I(WTO) is a dummy variable that takes 1 after Chinese accession to WTO, i.e.

$$I(WTO) = 1 \text{ if YEAR >= 2001}$$

$$= 0 \quad \text{otherwise}$$

I(MoreCHT) and I(NoCHT) are indicator variables that take 1 if the plant i at period t belongs to the respective groups as defined above. X_{ijst} is a vector of plant-level controls: logarithm of age, multi-plant dummy, entrant dummy (takes 1 if the plant enter that period), and exit dummy (takes 1 if the plant does not participate next period). We also have industry, state and year fixed effects.

In this specification we separate the variation in productivity due to WTO accession of China from other sources by exploiting not only the variation of productivity before and after WTO accession of China, but also across plants that are exposed to Chinese competition with differing degrees.

If there is an overall shift in the productivity after 2001 in all Maquiladoras then the coefficient μ_1 should be positive. Our difference in difference estimates of the effect of Chinese competition are represented by μ_3 and μ_5. The former indicates the productivity differential for sectors with heavy presence of Chinese imports in the corresponding US market compared to the sectors with moderate Chinese imports presence in the US market. The latter indicates the

productivity differential between the sectors which are not under the dominance of China compared to the sectors which are moderately affected by Chinese competition.

If Chinese competition makes plants more productive say through upgrading of production techniques, management and organizational skills, the coefficient μ_3 should be positive and the coefficient μ_5 should be negative.

Our regression model identifies the impact of Chinese competition on within productivity as our dependent variable is un-weighted productivity. But productivity will also be affected by reallocation at the extensive margin, that is, through entry and exit of plants. So we include entry and exit dummies to capture these effects.

Competition can also affect productivity through interacting with entry and exit of plants. As competition intensifies, low productivity firms may not be able to compete and exit and this increases aggregate productivity. Another likely consequence is that aggregate productivity increases through entry. This happens if entrant plants are more productive than an average plant. Assume a pool of potential entrants with different productivity levels. If competition decreases average profitability in the industry then the cut-off point of productivity at which potential entrant find entry profitable will be higher, as the expected value of entry becomes lower. We test these hypotheses by including interaction between entry and exit dummies with our WTO dummy.

In our specification in 6, we do not consider intensified competition from China as a gradual change. One way to investigate year by year change is to interact our group dummies with year dummies.

$$lnTFP_{ijst} = \mu_0 + \mu_1 I(MoreCHT)_i + \sum_t \mu_{2t} Year_t * I(MoreCHT)_i + \mu_3 X_{ijst} + \sum_j Industry_j + \sum_s State_s + \sum_t Year_t + \in_{ijst} \quad (7)$$

In this specification, μ_{2t}, will give the productivity differential between the plants that are exposed to high level of Chinese competition with others at each year t.

As a further check we also estimate the following equation:

$$lnTFP_{ijst} = \nu_0 + \nu_1 IMPCH_{jt} + \nu_2 Z_{jt} + \nu_3 X_{ijst} + \sum_j Industry_j + \sum_s State_s + \sum_t Year_t + \in_{ijst} \quad (8)$$

We now turn to the results.

2.5 Results

2.5.1 Employment Growth

In Table 2 we present the estimation of our employment growth equation. After we control for plant-level variables we find a statistically significant effect of Chinese share of import penetration on Mexican maquiladoras (column 2). In column 3, we additionally control for import penetration rate calculated without Chinese imports, *IMP*. That both coefficients are negative and significant indicates that import competition in the US market in general is associated with lower employment growth. Although the coefficient of Chinese share is bigger and significant at the 5 % level as opposed to the coefficient of import penetration rate, *IMP*, which is significant at the 10 %, the Wald test cannot reject that both of the coefficients are equal.

The coefficient in front of the Chinese share of import penetration in column 4 indicates that a one standard deviation increase in Chinese share of import penetration rate is associated with a decrease in annual plant employment growth of 6.2 percentage points.

In columns 5 and 6 of Table 2 we present instrumental variable regression results when we instrument our Chinese imports variable, *IMPCH*, as well as our other import penetration variable, *IMP*, with the instruments described in the previous section. The results confirm that Chinese imports in the US market are associated with lower employment growth in Maquiladora industries.

Our plant-level coefficients in all of our regressions are significant except the multi-plant dummy and they all have the expected signs. Employment growth increases with productivity, decreases with age, and decreases with size.[12][13]

In Table 3 in columns 1, 2 and 3 we present our results when we interact our Chinese competition proxy with plant TFP, skill intensity as measured by the ratio of non-production workers to production workers and capital intensity as measured by the rental expenditures of machinery, equipment and building to value added respectively. None of the interaction terms are significant, so there is no indication that intensified Chinese competition as proxied with Chinese share of import penetration rate in the US causes disproportionate decrease in

[12] Coefficients of size dummies and multi-plant dummy (additional plant-level controls) are not reported but are available upon request. Size dummies are all negative and significant at the 1 % level. The multi-plant dummy is positive and insignificant.

[13] It is usual to find that younger and smaller firms and plants grow faster conditional on survival (Dunne et al. (1989)). Jovanovic (1982) provides a theoretical foundation through learning.

Table 2: The Impact of Chinese Competition on Employment I

	(1)	(2)	(3)	(4)	(5)	(6)
Specification	OLS	OLS	OLS	OLS	IV	IV
Dependent Variable	ΔlnE	ΔlnE	ΔlnE	ΔlnE	ΔlnE	ΔlnE
$IMPCH_{jt-1}$	-0.488	-0.725	-1.052	-1.059	-1.190	-1.239
	(0.357)	(0.308)*	(0.329)**	(0.429)**	(0.454)***	(0.330)***
IMP_{jt-1}			-0.757	-0.789		-0.939
			(0.328)*	(0.352)*		(0.217)***
$lnTFP_{ijst-1}$		0.131	0.123	0.124	0.121	0.132
		(0.035)***	(0.033)***	(0.033)***	(0.027)***	(0.027)***
$LogAge_{ijst-1}$		-0.813	-0.808	-0.809	-0.813	-0.811
		(0.029)***	(0.028)***	(0.028)***	(0.017)***	(0.017)***
Additional Plant-Level Controls	No	Yes	Yes	Yes	Yes	Yes
Additional Industry-Level Controls	No	No	No	Yes	No	No
State-Year Fixed Effects	✓	✓	✓	✓	✓	✓
Plant Fixed Effects	✓	✓	✓	✓	✓	✓
Number of Plants	3540	3122	3122	3122	2643	2578
Number of Observations	23743	18525	18525	18525	18046	17277
R^2	0.1232	0.3086	0.3094	0.3094	0.3085	0.3142
$SheaPartialR^2$					0.3088	0.6954-0.8060
Sargan Test					0.029 ($\chi(1)$)	4.610($\chi(3)$)

Note: Dependent variable is the change in the employment between t and t+1. Robust standard errors are reported in parentheses. For the OLS estimates standard errors are clustered for each industry in each year. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Additional plant-level controls include size dummies, and multi-plant dummy which is an indicator variable if the plant is a part of multi-plant company. Additional industry-level controls include Mexican industry hourly wages relative to the US industry, and production index of the US industry. For IV regressions instruments we use are explained in the text. Constant is included but not reported.

Table 3: The Impact of Chinese Competition on Employment II

Dependent Variable	ΔlnE	ΔlnE	ΔlnE
$IMPCH_{jt-1}$	-0.951	-1.034	-1.202
	(0.344)**	(0.412)*	(0.453)**
IMP_{jt-1}	-0.738	-0.880	-0.837
	(0.354)*	(0.366)*	(0.352)*
$lnTFP_{ijt-1}$	0.172	0.089	0.103
	(0.042)***	(0.038)*	(0.039)**
Skill Intensity $\log(\mathrm{NP/P})_{ijt-1}$		0.007	
		(0.015)	
Capital Intensity $\log(\mathrm{K/Y})_{ijt-1}$			0.006
			(0.005)
$IMPCH_{jt-1} * lnTFP_{ijt-1}$	-0.797		
	(0.520)		
$IMPCH_{jt-1} *$ Skill Intensity $\log(\mathrm{NP/P})_{ijt-1}$		-0.006	
		(0.180)	
$IMPCH_{jt-1} *$ Capital Intensity $\log(\mathrm{K/Y})_{ijt-1}$			-0.033
			(0.070)
Plant-Level Controls	Yes	Yes	Yes
Industry-Level Controls	Yes	Yes	Yes
State-Year Fixed Effects	✓	✓	✓
Plant Fixed Effects	✓	✓	✓
Number of Plants	3122	3101	3090
Number of Observations	18525	18439	18393
R^2	0.3095	0.3087	0.3067

Note: Dependent variable is the change in the employment between t and t+1. Robust standard errors are reported in parentheses. They are clustered for each industry in each year. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Plant-level controls include multi-plant dummy and size dummies and logarithm of age. Industry-level controls include Mexican industry hourly wages relative to the US industry, and production index of the US industry. Constant is included but not reported.

employment growth, especially in the group of low-productivity plants, low-skill intensive plants or low capital-intensive plants. This could be expected as the substitutability between the Chinese export bundle and the Maquiladora export bundle is quite high and there is no apparent ranking between them. That is, we do not expect Chinese exports to the US to exhibit higher substitutability with the lower end of the distribution of maquiladora products in comparison to the upper end for a given industry. Although for example, as Bloom et al. (2009) finds it is more plausible to think that imports from China to Europe compete more with the European firms' products located at the low end of the distribution.

2.5.2 Employment at the Extensive Margin

2.5.2.1 Entry of New Plants

We now turn our attention to the question of whether entry of new plants into the Maquiladora program is affected by intensified Chinese competition. In Table 5 we present the estimates of equation 4. In column 1, we regress $ln(1 + ENTRY_{jt})$ on the Chinese competition proxy and industry fixed effects. We find a negative and significant effect of the Chinese share of import penetration on entry. However, in column 1 we do not control for aggregate factors such as exchange rate fluctuations or policy changes such as implementation of NAFTA that may affect the entry decision in the same way across sectors. In column 2, we additionally control for year fixed effects and our coefficient of interest increased its magnitude.

Can this effect be generalized to imports from everywhere else? Or is it especially true for Chinese competition? We add the import penetration rate in column 3. Interestingly, we find no significant effect of import penetration in the US market on entry of offshoring plants in Mexico. Another potential factor that may affect entry decisions is relative cost of production in the US versus in Mexico. We include industry hourly wages of unskilled workers in the Mexican

Table 4: The impact of Chinese Competition on Entry to Mexican Offshoring Industry

	(1)	(2)	(3)	(4)	(5)
Specification	OLS	OLS	OLS	OLS	OLS
Variables	$ln(ENTRY+1)$	$ln(ENTRY+1)$	$ln(ENTRY+1)$	$ln(ENTRY+1)$	$ln(ENTRY+1)$
IMPCH	-2.318	-3.972	-4.042	-3.738	-3.266
	(0.659)***	(0.994)***	(1.087)***	(0.963)***	(0.989)**
IMP			-0.170		
			(0.856)		
Relative Wage ($\frac{MxWage_{jt}}{USWage_{jt}}$)				-1.894	-1.769
				(0.633)**	(0.696)*
Industry Specific Exchange Rate ($lnMER_jt$)					-2.939
					(1.071)**
Industry Fixed Effects	✓	✓	✓	✓	✓
Year Fixed Effects	No	✓	✓	✓	✓
N	176	176	176	176	176
R^2	0.815	0.845	0.846	0.851	0.858

Dependent variable is the logarithm of one plus the total number of entrants at period t and industry j. Robust standard errors are reported in parentheses. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported.

Table 5: The impact of Chinese Competition on Entry to Mexican Offshoring Industry

Specification	(1) Negative Binomial	(2) Negative Binomial	(3) Negative Binomial	(4) Negative Binomial	(5) Negative Binomial
Variables	$ENTRY$	$ENTRY$	$ENTRY$	$ENTRY$	$ENTRY$
IMPCH	-3.088	-6.740	-7.087	-6.632	-5.543
	(0.766)***	(1.141)***	(1.157)***	(1.140)***	(1.165)***
IMP			-1.163		
			(0.733)		
Relative Wage ($\frac{MXWage_{jt}}{USWage_{jt}}$)				-1.932	-2.070
				(0.881)*	(0.902)*
Industry Specific Exchange Rate ($lnMER_jt$)					-3.219
					(0.980)**
$ln(\alpha)$ (over-dispersion parameter)	-2.326	-3.041	-3.124	-3.053	-3.216
	(0.183)***	(0.267)***	(0.295)***	(0.265)***	(0.284)***
Industry Fixed Effects	✓	✓	✓	✓	
Year Fixed Effects	No	✓	✓	✓	
N	176	176	176	176	176
Log pseudolikelihood	-507.822	-484.301	-483.246	-482.293	-477.275

Dependent variable is the total number of entrants at period t and industry j. Robust standard errors are reported in parentheses. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported.

maquiladora sectors relative to the corresponding US industries in column 4. We find the coefficient of the relative wage negative and significant at the 5 % level. As one may expect, cost factors play an important role for entry of an offshoring plant. One may think that our import-penetration rate for the US industry as described in equation 2 does not abstract the competition effect from other factors that are associated with imports. We use an alternative measure of the 'general level of competitiveness' of the US market in the last column: It is the industry-specific exchange rate constructed using import partner's shares in total imports in the particular US industry, *lnMER*. An increase in this measure refers to the appreciation of the US dollar. We find a negative and significant effect indicating that decrease in the level competitiveness of the US industry is associated with lower rate of entry to the Mexican maquiladoras. But our Chinese share of import penetration rate keeps its sign and significance in column 5.

One criticism to our OLS regressions presented in Table 4 is that entry is a count data and simple transformation of it using logarithm is not appropriate as one may suspect that the error structure may not exhibit normal distribution. We use the count data nature of our variable and estimated the same regressions (without transforming the dependent variable) using Poisson and negative binomial regressions. We present only the negative binomial regression results in Table 5 because our entry variable exhibits over-dispersion. Looking at Table 5, we find results quite similar to the OLS results. We now turn to the impact of Chinese competition on plant exits.

2.5.2.2 Exit

In Table 6 we present the results from our probit regression for plant exits. In column 1, we regress the exit indicator on plant-level variables that may affect exit decisions and our Chinese competition proxy, China's share of the penetration rate in the US market. Let us first discuss the coefficients of the plant-level variables.

As one may expect we find a significant and negative relationship between exit and size as well as between exit and productivity. We also find evidence of the presence of non linearities in the relationship between productivity and exit. The impact of productivity on exit diminishes with productivity (negative and significant coefficient of productivity square). Entrants are less likely to exit and as the plants age, the probability of exit increases. These findings indicate that offshoring plant dynamics may be different than the plants that are usually studied using manufacturing survey data. It is typical to find a higher exit rate among younger firms/plants, since they enter without full information about their capabilities or opportunities; so as they age, their likelihood of exit decreases.[14][15]Offshoring plants on the other hand are mostly owned by large multi-nationals. When an offshoring plant starts an operation it starts with a business tie with a company with safe demand (already accumulated demand) but as time goes by, the offshoring plants' probability to lose the business tie might increase, perhaps due to bankruptcy or other reasons. Our findings indicate a need for a closer look at offshoring plants dynamics.[16] The demand accumulation process is expected to play a minimum role in an offshoring industry like Mexican Maquiladoras, however it is probably an important factor in causing different behavior of plants with different age in the usual manufacturing data.

Turning our attention back to the impact of Chinese competition, we find a positive coefficient of the Chinese penetration rate, however, is not significant. In column 2 we also add

[14] See for example Dunne et al. (1989) for a study of plant dynamics using the US manufacturing plants.
[15] In the dynamic stochastic industry evolution models, it is usual to assume that potential entrants do not know their own productivity but holds an expectation over it when they make their entry decision, see for example Utar (2007).
[16] In a work-in progress, we are looking further into the dynamics of offshoring industry.

Table 6: Probit Estimates:Plant Exits

	(1)	(2)	(3)
Specification	Probit	Probit	IV
Variables	χ	χ	χ
IMPCH	0.723	1.251	1.145
	(0.957)	(0.911)	(1.389)
IMP		1.236	
		(0.543)*	
Relative Wage ($\frac{MXWage_{jt-1}}{USWage_{jt-1}}$)		0.757	
		(0.465)	
Log Labor	-0.385	-0.386	-0.385
	(0.019)***	(0.019)***	(0.019)***
Productivity	-0.259	-0.266	-0.260
	(0.092)**	(0.093)**	(0.092)***
Productivity Square	0.300	0.304	0.301
	(0.066)***	(0.066)***	(0.066)***
Log Age	0.170	0.171	0.169
	(0.038)***	(0.038)***	(0.038)***
Entrant Dummy	-0.693	-0.686	-0.694
	(0.096)***	(0.096)***	(0.096)***
Multi-plant Dummy	0.035	0.034	0.035
	(0.43)	(0.43)	(0.43)
State Fixed Effects	✓	✓	✓
Industry Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
N	18907	18907	18907
Pseudo R^2	0.2242	0.2253	

Robust standard errors are reported in parentheses. They are clustered for each industry in each year. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported. In the IV regression, Wald test does not reject exogeneity of $IMPCH$.

the import penetration rate in the US market, *IMP*. The coefficient is positive and significant at the 10 % level. As the general import-penetration increases in the US market, maquiladora plants' likelihood of exit increases in Mexico. This is probably because, as US firms face lower demand for their products, they consider shutting down their offshoringplants in Mexico.[17] The coefficient of relative wage is positive but insignificant. In column 3 we also present our results when we instrument our Chinese proxy (the Wald test does not reject the exogeneity of Chinese import penetration (p=0.6738)) with instruments as explained in the previous section. Our results are robust.

As a further robustness check, we also look at the impact of Chinese competition on plant exit using the dummy group approach as described in section 2.5. The results of this exercise are presented in Table 10. We find that the probability of exit increases after 2001. The coefficients on the interaction terms have the expected signs: The coefficient of the interaction between the WTO dummy and plants that belong to the most affected sectors is positive; and the coefficient of the interaction between WTO dummy and plants that belong to the nonaffected sectors is negative (in comparison to our excluded group). But they are insignificant, confirming our finding with the Chinese share of import-penetration rate. This shows that competition from China is not a significant factor in causing plant exits among Mexican maquiladoras.

2.5.3 Within Firm Productivity

Our difference in difference estimation results for plant TFP are presented in Table 7. Our TFP measure is calculated separately for each industry allowing differing technologies as described in the Appendix. We include industry fixed effects to control for the variation of

[17] Bergin et al. (2009) documents excess volatility of maquiladoras in comparison to the US counterpart which may imply that the US firms respond to shocks more strongly in their offshoring plants.

productivity levels between industries. We also include time fixed effects to control for common shocks. In column (1) of Table 7 we present the regression result where we only include the top group *MoreCHT*.

We find that the coefficient of the WTO dummy is positive and significant, indicating a general shift in the productivity of export assembly plants in Mexico in 2000s. Indeed, although not reported, we quantified in general 8.6 % increase in the productivity of maquiladora plants after controlling industry and state fixed effects after 2001. It is difficult to attribute this gain to intensified Chinese competition only, as there may be other changes in the aggregate environment that cause a productivity shift in maquiladora plants. One potential explanation is implementation of the rules of origin in 2001 due to NAFTA.[18] However, our difference in difference approach will be able to extract the role of Chinese competition from other changes.

The coefficient of the interaction between the WTO dummy and the group of sectors that are under the most direct threat of Chinese competition, *MoreCHT*, is found to be positive and significant. It indicates that the productivity increase after China's accession to WTO is higher for the plants that are belong to the sectors with stronger Chinese comparative advantage. More specifically, after WTO accession of China, productivity of plants in group *MORECHT* becomes 5.7 % higher than the productivity of rest of the plants after controlling for aggregate shocks.

The coefficient in front of the entrant dummy is positive and significant at the 10 % level, this is not usual in the firm dynamics literature. We expect that entrants are generally

[18] Although this rule took place in 2001, subsequent complaints from the maquiladora industries led the Mexican government put an exemption on maquiladora plants. One may also argue, the rules of origin would lead decrease in productivity rather than increase as it would decrease the diversity of imports.

Table 7: The Impact of Chinese Competition on Productivity I

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	lnTFP	lnTFP	lnTFP	lnTFP	lnTFP	lnTFP	lnTFP	lnTFP
WTO	0.069	0.093	0.081	0.074	0.126	0.141	0.136	0.143
	(0.013)***	(0.013)***	(0.013)***	(0.013)***	(0.034)***	(0.034)***	(0.034)***	(0.034)***
MoreCHT	-0.170		-0.158	-0.159				
	(0.077)*		(0.020)***	(0.020)***				
MoreCHT*WTO	0.057		0.046	0.044	0.043		0.035	0.034
	(0.013)***		(0.014)***	(0.014)***	(0.012)***		(0.012)**	(0.012)**
NoCHT		0.175	0.025	0.025				
		(0.078)*	(0.077)	(0.077)				
NoCHT*WTO		-0.061	-0.048	-0.048		-0.041	-0.032	-0.031
		(0.015)***	(0.015)**	(0.015)**		(0.014)**	(0.014)*	(0.014)*
Log Age	-0.003	-0.002	-0.002	-0.001	-0.023	-0.023	-0.024	-0.026
	(0.006)	(0.006)	(0.006)	(0.006)	(0.013)	(0.013)	(0.013)	(0.013)*
Multi-Plant Dummy	0.030	0.030	0.030	0.030	0.019	0.018	0.019	0.019
	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.012)	(0.012)	(0.010)	(0.012)
Entrant Dummy	0.023	0.023	0.023	0.010	0.009	0.009	0.013	-0.001
	(0.010)*	(0.010)*	(0.010)*	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Entrant*WTO				0.046				0.030
				(0.018)**				(0.017)
Exit Dummy	-0.016	-0.016	-0.017	-0.033	0.010	0.011	0.010	-0.018
	(0.011)	(0.011)	(0.011)	(0.016)*	(0.009)	(0.009)	(0.009)	(0.011)
Exit*WTO				0.028				0.044
				(0.022)				(0.017)*
Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
State Fixed Effects	✓	✓	✓	✓	No	No	No	No
Industry Fixed Effects	✓	✓	✓	✓	No	No	No	No
Plant Fixed Effects	No	No	No	No	✓	✓	✓	✓
Number of Plants	3116	3116	3116	3116	3116	3116	3116	3116
Number of Observations	18907	18907	18907	18907	18907	18907	18907	18907
R^2	0.199	0.199	0.202	0.202	0.042	0.041	0.043	0.044

Note: Dependent variable is the logarithm of productivity. Robust standard errors are reported in parentheses. They are clustered for plants. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported.

more productive than exiting plants so the turnover rate increases aggregate productivity. However, net entry is generally thought to be a negative contributor to the aggregate productivity as new entrants are on average found to be less productive than the average.[19] However, all empirical findings until now have been based on manufacturing firms and we do not know any study that investigates plant dynamics in an offshoring industry.[20] If demand accumulation process does not play a significant role among offshoring plants, as we discussed in the previous section, then we do not expect younger plants to charge a lower price than the older plants, everything else is being constant. Accordingly, our productivity estimates will not underestimate the productivity of entrants due to omitted price problem. So in one sense, we confirm the findings of Foster et al. (2008) that entrants are not necessarily less productive than the incumbents after controlling for demand disadvantages of entrants.

The exit dummy is negative indicating that, on average, exiting plants are less productive, but this coefficient is not found to be statistically significant. This is in line with our previous findings that aggregate demand factors are playing a role in plant exits as well as there are non-linearities in the relationship between productivity and exit.

In column (2) of Table 7 we repeat the same analysis for the group of plants that belong to the least affected sectors, *NoCHT*. We find that the interaction between the WTO dummy and *NoCHT* is negative and significant. More specifically, plants that belong to the sectors were Chinese comparative advantage is not strong (Chemicals, Transportation and Food), are on

[19] Foster et al. (2008) and Foster et al. (2009) find on the other hand that entrants are not necessarily less productive than the incumbent plants after controlling for demand side factors.
[20] In an accompanying paper where we analyze productivity dynamics of offshoring industry, we find that non-negative contribution of entry is robust to different productivity estimates.

average 6.1 % less productive in comparison to the rest of the plants after China's accession to WTO.

In column (3), we included both groups, *MoreCHT*, and *NoCHT*, so that the interaction terms will indicate the productivity differential between that group and the excluded group, which is the group with medium exposure to Chinese imports. The coefficient of the WTO dummy is positive and significant, indicating that productivity increases 8 % on average after China's accession. The coefficient of *MoreCHT***WTO* is positive and significant, and the coefficient of *NoCHT***WTO* is negative and significant. Our difference in difference estimates confirm that heightened Chinese competition leads to within firm productivity increase in Mexican maquiladoras.

Does the competition have effect on productivity through entry and exit? Column (4) of Table 7 shows that the coefficient of the entrant dummy loses its significance after inclusion of the interaction between entry and WTO dummies. Instead, the coefficient of the interaction effect becomes positive and significant, indicating that after 2001 entrants started to become more productive. It is interesting that the most of the positive effect of entry is indeed after the competition with China is intensified. We find support for a hypothesis that intensified competition with China increases the cut-off level of productivity at which a potential entrant will be indifferent between starting up a plant or not. Only plants with a high level of productive opportunities enter. We also look at the skill intensity (non-production workers over production workers)of the entrants and find that the mean skill-intensity of entrants before 2001 is 0.339 and the mean intensity of entrants after 2001 is 0.609 which supports our finding with productivity levels. This is not due lower size of entrants after 2001 since the mean size of entrants slightly increases in comparison to pre-2001 level too. This is also in line with Heckscher-Ohlin theory

which suggests growth in skill-intensive jobs in Mexico as a result of competition from low skill intensive China.[21]

Looking at exit, after inclusion of interaction, the exit dummy becomes significant (and negative) at the 10 % level. The coefficient of the interaction between exit and WTO is positive but insignificant. This could be due to US firms shutting down its sufficiently productive plants in Mexico and moving them to China as trade costs with China decrease.[22]

From Column (5) through column(8) we repeat the analysis with the inclusion of plant-fixed effects. In these regressions the time-invariant variables were removed due to the inclusion of deterministic fixed effects. The basic picture does not change. That, there is significant within productivity improvement after 2001 and this effect is stronger for the plants with more exposure to Chinese imports. Moderately productive plants cease production as probably some of the multi-national firms move labor intensive production stages from Mexico to cheaper places, such as China.

What is the over-time impact of Chinese accession to WTO on the productivity of Mexican maquiladoras? The results presented in Table 8 tell us that the effect of competition on productivity increases over time as China performs better and better each year. The productivity differential of the most effected group of plants and the rest of the maquiladoras is 7.3 % on average in 2002, and this becomes 9.1 % on average in 2005 (column 1). To be able to extend the years until 2006, exit dummy is excluded in column 2. The results are similar. The estimates are also robust to the inclusion of plant fixed effects (column (3) and (4)).

[21] Indeed, among continuing plants, skill-intensity is on average 0.28 before 2001 in comparison to 0.38 after 2001.
[22] Again we should be careful not to over-interpret our results, since the interaction term is found to be insignificant. However, interaction between exit and the WTO dummy becomes significant once we include our plant-level fixed effects.

Table 8: The Impact of Chinese Competition on Productivity II

Dependent Variable	(1) lnTFP	(2) lnTFP	(3) lnTFP	(4) lnTFP
MoreCHT	-0.177	-0.177		
	(0.080)*	(0.045)**		
MoreCHT*1992	0.007	0.006	0.002	0.002
	(0.017)	(0.017)	(0.014)	(0.014)
MoreCHT*1993	-0.012	-0.013	-0.016	-0.016
	(0.020)	(0.020)	(0.017)	(0.017)
MoreCHT*1994	0.016	0.016	0.011	0.011
	(0.023)	(0.023)	(0.018)	(0.018)
MoreCHT*1995	0.005	0.005	0.019	0.019
	(0.023)	(0.023)	(0.020)	(0.020)
MoreCHT*1996	-0.002	-0.002	0.020	0.020
	(0.023)	(0.024)	(0.021)	(0.021)
MoreCHT*1997	0.022	0.021	0.021	0.021
	(0.024)	(0.024)	(0.022)	(0.022)
MoreCHT*1998	0.017	0.016	0.006	0.006
	(0.024)	(0.024)	(0.021)	(0.021)
MoreCHT*1999	0.025	0.024	0.028	0.029
	(0.025)	(0.025)	(0.021)	(0.021)
MoreCHT*2000	0.001	0.000	0.002	0.002
	(0.024)	(0.024)	(0.020)	(0.021)
MoreCHT*2001	0.035	0.033	0.028	0.029
	(0.026)	(0.026)	(0.023)	(0.023)
MoreCHT*2002	0.073	0.071	0.065	0.067
	(0.028)*	(0.028)*	(0.025)**	(0.025)**
MoreCHT*2003	0.065	0.063	0.063	0.065
	(0.028)*	(0.028)*	(0.025)*	(0.025)**
MoreCHT*2004	0.080	0.078	0.069	0.070
	(0.026)**	(0.026)**	(0.025)**	(0.025)**
MoreCHT*2005	0.091	0.088	0.081	0.080
	(0.029)**	(0.029)**	(0.026)**	(0.026)**
MoreCHT*2006		0.091		0.091
		(0.025)***		(0.025)***
Log Age	-0.002	0.001	-0.023	-0.024
	(0.006)	(0.006)	(0.013)	(0.012)
Multi-Plant Dummy	0.030	0.028	0.020	0.021
	(0.009)***	(0.008)***	(0.012)	(0.011)
Entrant Dummy	0.023	0.027	0.009	0.008
	(0.010)*	(0.009)**	(0.010)	(0.010)
Exit Dummy	-0.017		0.010	
	(0.011)		(0.009)	
Year Fixed Effects	✓	✓	✓	✓
State Fixed Effects	✓	✓	No	No
Industry Fixed Effects	✓	✓	No	No
Plant Fixed Effects	No	No	✓	✓
Number of Plants	3116	3116	3116	3116
Number of Observations	18907	18907	18907	18907
R^2	0.201	0.208	0.041	0.043

Note: Dependent variable is the logarithm of productivity. Robust standard errors are reported in parentheses. They are clustered for plants. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported. In columns (2) and (4) we exclude exit dummy in order to include Year 2006 dummy, since exit is not defined in 2006 as we do not observe 2007.

In Table 9 we present our results when using the continuous proxy for Chinese competition, Chinese import penetration in the US market, *IMPCH*. In column (1), the coefficient of *IMPCH* implies that one standard deviation increase in Chinese import penetration in the US market increases the productivity of maquiladoras by 10.2 percentage points. When we control for import-penetration rate (imports from everywhere else), one standard deviation increase in Chinese import-penetration increases productivity by 12.6 percentage points (column (2)). When we add interaction of our entry and exit dummies with the Chinese competition proxy (columns 3 and 4) we confirm our previous findings in Table 7. As competition becomes tougher, the contribution of entry to aggregate productivity increases as a more selective group of potential entrants chooses to enter (Schumpeterian effect). We also confirm our findings about exit, that intensified exit due to competition does not necessarily affect low productivity plants. Indeed, it seems that Chinese competition is associated with exiting plants that are on average more productive than the survivals as the interaction between exit dummy and *IMPCH* is positive and significant. Again this maybe because of firm-level adjustment to lower trade costs in China. As China becomes a cheaper destination to offshore to, some firms may want to move their plants from Mexico to China. Since this is a fixed cost activity, we may expect that only more productive firms will choose to relocate their plants across different destinations (shutting down a maquiladora and opening up a plant in China), while less productive ones may choose to respond at the intensive margin.

Table 9: The Impact of Chinese Competition on Productivity III

	(1)	(2)	(3)	(4)
Dependent Variable	lnTFP	lnTFP	lnTFP	lnTFP
IMPCH	0.489	0.606	0.542	0.455
	(0.136)***	(0.125)***	(0.126)***	(0.125)***
IMP		0.308	0.300	0.190
		(0.068)***	(0.068)***	(0.093)*
Log Age	-0.003	-0.002	-0.002	-0.023
	(0.004)	(0.004)	(0.004)	(0.009)*
Multi-Plant Dummy	0.030	0.030	0.029	0.019
	(0.005)***	(0.005)***	(0.005)***	(0.007)**
Entrant Dummy	0.023	0.024	0.013	-0.005
	(0.010)*	(0.010)*	(0.013)	(0.011)
Entrant*IMPCH			0.197	0.265
			(0.122)	(0.115)*
Exit Dummy	-0.015	-0.017	-0.047	-0.029
	(0.013)	(0.013)	(0.017)**	(0.011)*
Exit*IMPCH			0.393	0.498
			(0.163)*	(0.127)***
Year Fixed Effects	✓	✓	✓	✓
State Fixed Effects	✓	✓	✓	No
Industry Fixed Effects	✓	✓	✓	No
Plant Fixed Effects	No	No	No	✓
Number of Plants	3116	3116	3116	3116
Number of Observations	18907	18907	18907	18907
R^2	0.200	0.201	0.202	0.043

Note: Dependent variable is the logarithm of productivity. Robust standard errors are reported in parentheses. They are clustered for each industry in each year. *, ** and *** indicate significance at the 10 %, 5% and 1% levels respectively. Constant is included but not reported.

2.6 Conclusion

We analyze the impact of Chinese competition on Mexican export assembly plants, (Maquiladoras) using plant-level data set that covers the period from 1990 to 2006. We find that employment growth and entry are negatively affected by Chinese competition. We quantified a positive, and both economically and statistically significant productivity improvement in Mexican maquiladoras in 2000s. We also quantified significant and positive effect of intensified Chinese competition on within productivity of Mexican maquiladoras. The results provide evidence in support of models that imply a positive relationship between international competition and within firm productivity.

We also highlight that offshoring plants dynamics exhibit different patterns in contrast to the plant dynamics mostly studied in manufacturing survey data. We find that entrants are not necessarily less productive than incumbent plants. We also find probability of exit increases with plants' age. More specifically, the lack of demand accumulation concerns among offshoring plants could be one factor that drive differences.

The results also indicate that plant exit decisions are given at the firm-level. Relocation of plants from one location to another may imply that firms choose to relocate are more productive than ones choose to respond to intensified competition from China at the intensive margin due to sunk costs associated with relocation.

Overall we identify an interesting link between competition between two popular offshoring destinations for the US firms (Mexico and China) and within plant productivity improvement that may relieve some of the worries that Mexican policy makers express over growing trade from China.

CHAPTER III

MAQUILADORA DEFEMINIZATION AND THE GENDER EARNINGS GAP

3.1 Introduction

A characteristic of export promotion and trade-liberalization policies in developing countries is the high ratio of female to male workers in Export Oriented Industries (EOI). The relationship between EOI and feminization -- a growing ratio of female workers to male workers -- pertains in all developing countries, no matter their wage levels or the previous levels of female employment, or the skill qualifications of the female labor force, or even the cultural norms for female employment. An explanation for this is that women in developing countries typically enter the labor market with lower levels of education, so that female workers tend to earn lower wages. In addition EOI are labor-intensive industries with low skill requirements. Women become the preferred labor force in EOI as predicted by the theory of comparative advantage.

The initial EOI typically began with the manufacturing of clothing and footwear, followed by the production of electronic products after industrial diversification has taken place. In all of these industries women constitute the majority of the workforce. The evolution of EOI in developing countries has introduced new technologies and the upgrading of skills, causing a change in the industry mix from less labor-intensive to more capital-intensive. The changes in skill requirements have been accompanied by a de-feminization trend: a fall in the ratio of female workers to male workers. So, as the education and training-level requirements have increased, a displacement of female workers by male workers has been observed.

This same pattern has been observed in the Mexican maquiladora industry, an EOI. As the maquiladora industry has evolved from labor-intensive plants employing low-skilled workers to more advanced manufacturing processes, a trend of de-feminization has been observed: the participation of women workers has decreased while that of man has increased. The maquiladora plants have historically specialized in labor-intensive products such as apparel, footwear, electronic equipment and toys. But as they have evolved, maquiladoras are now becoming more specialized in more capital-intensive products like transportation equipment, the assembly of machinery, electrical equipment and electronic devices. The Mexican maquiladora industry exemplifies the change in factor endowments to a greater share of more capital-intensive produced goods. It provides an opportunity to analyze the decline in the percentages of female workers in EOI over time as plants have become more capital-intensive.

There is now a growing recognition of the gender dimensions of international trade in developing countries (Sing and Zammit, 2000). Recent efforts have been aimed toward investigating gender impacts of international trade on income and employment. Previous cross-country analysis found that export promotion and trade liberalization policies have led to a higher ratio of female workers to male workers in the labor forces of developing countries (Wood, 1991; Catagay & Ozler, 1995). It has shown the preference for female workers in labor-intensive assembly operations around the developing world (Pearson, 1991). Support for this trend has been found in a number of cases in developing countries in which feminization of the labor force is associated with EOI (Catagay & Berik, 1991). The movement toward or away from feminization is found to vary across countries (Joekes, 1995) based on the growth of employment in labor-intensive sectors relative to capital-intensive sectors (Caraway, 2007). Past research has demonstrated a relationship between the falling female share in the workforce and

the rise in production of more capital-intensive goods (Joekes, 1995). Other findings in regard to the movement towards de-feminization of the maquiladora industry suggest four reasons for the phenomenon: employers perceive a reduced unionization of male workers (Kopinak 1995; Sklair 1993); there has been a growth in the presence of multinational firms and a shift in the perception by employees of the ideal worker from a young, single woman to a married man or woman (Kopinak 1995; Stoddard 1987; Tiano 1994); industries that traditionally have employed a larger proportion of men have expanded (Catanzarite and Strober 1993); and the skewed female-male employment ratio has decreased over time in all industries (Jiménez Bentacourt 1989).

Because of the diversity of the observed patterns and the fundamental causes of feminization, cross-country and industry analysis of feminization can be improved and complemented by plant-level evidence (Ozler, 2000). Plant level analysis allows for the heterogeneity of plant characteristics, like skill-intensity, to be addressed. In the case of cross-country and industry level information some narrowly defined questions are likely to elicit misleading answers (Ozler, 2000). One such answer could be the net change in employment at the industry level, since jobs could be reallocated within the same industry leaving net employment about the same while employees may have shifted from small to large plants or vice versa. Previous research into plant-level feminization has found that plant-level data allows for better control of the determinants of the female share of employment such as capital intensity and the size of the plant (Ozler, 2000).

Plant-level studies across different manufacturing industries are scarce especially any that investigate gender issues. For that matter maquiladora feminization research at the plant level is

non-existent. This study investigates the impact of plant and labor supply characteristics on female participation in the maquiladora workforce, utilizing plant level data that covers the population of maquiladora plants for the 17 major maquiladora cities from 1990 to 2005. The ratio of female workers to male is also investigated in eleven manufacturing industries and one service industry. Plant characteristics include: skill, capital intensity, size and age. Labor supply characteristics include: years of schooling; number of children, and both marital and migration status. The period is well suited to study of the effects of an increase in capital endowments on the participation of women in the maquiladora industry, since previous research has discovered that the industry experienced a structural change during this period as a direct result of the increase in Chinese competition (Utar and Torres, 2010), which caused a movement toward more capital- intensive manufacturing (Cañas, Coronado and Gilmer, 2004).

The participation of women in the labor force has been linked to the wage gender earnings gap, were the gains in participation of women in the labor force are associated with a reduction in the earnings differences between women and men. Prior research that has investigated EOI in developing countries has found that feminization is necessary but not sufficient to eliminate the gender wage gap (Carraway, 2007). Previous research into the maquiladora industry has found that a greater concentration of women in an industry and an increase in capital intensity increases the gender-wage gap, while location in non-border regions diminishes the differences in earnings (Fleck, 2001).

In addition, this study examines the relationship between the gender-wage gap, and the participation of women in the workforce. The impact of feminization on earnings is investigated using plant- level data that covers all of the maquiladora plant population in the 17 major

maquiladora cities from 1997 through 2005. This study is one of the first to examine this relationship at the plant level in both manufacturing and service industries.

In the remainder of the paper, a review of literature will be presented. Then, the maquiladora industry will be examined, along with a description of the data that includes: the estimation procedure and relationship between de-feminization and the earnings gap. Next, the methodology will be presented along with the testable hypothesis. This will lead the way in to a discussion of the empirical results and findings. Finally, conclusions will be presented.

3.2 Empirical literature motivation

Notwithstanding numerous studies of employment and wage gaps as a consequence of export promotion and trade liberalization, the impacts of international trade on gender have not received the same attention in the realm of economic analysis (Ozler, 2000). Cross-country research on EOI in developing countries has discovered a broad trend of feminization of the labor force (Wood, 1991; Cagatay & Ozler, 1995; Ozler, 2000). Proof for this trend is found in a large number of country cases that link feminization of the labor force in developing countries with trade-liberalization policies (Catagay & Berik, 1991; Ozler, 2000). The route towards feminization or away from feminization is uneven across countries (Joekes, 1995). A contributing factor to the degree of feminization of EOI has been the growth of employment in labor-intensive versus capital-intensive industries (Caraway, 2007). Women have been the preferred labor force in labor-intensive EOI and represent the ultimate expression of the forces of comparative advantage (Joekes, 1995). The fact that women typically enter the labor market with lower levels of educational attainment than men and the intermittent interruption of their employment makes them the lowest-wage source of labor in developing countries. However, as

input labor requirements change from low to high-skilled, women´s participation in the labor force in EOI starts to decline (Carraway, 2007; Fleck, 2001).

Cross-country sectional studies have found that the differences in gender patterns in the workforce can be explained by capital-intensity, employment growth, labor unions, and fertility (Carraway, 2007). Literature on the maquiladora industry has established four motives for a de-feminization trend (Fleck, 2001): a reduced militancy of the male worker in unions (Kopinak, 1995; Skair, 1993); a growth in the presence of multinational firms in conjunction with a change in the perception of the ideal worker from a single woman to a married man or woman (Kopinak, 1995; Tiano, 1997); expansion of traditional male industries (Catanzire and Strober, 1993); and the reduction over time of the female/male employment ratio in all industries (Jimenez, 1989). Another reason presented for the de-feminization trend in the maquiladora industry is that relatively more men are looking for work in maquiladora plants, - because of wage convergence between other manufacturing jobs and maquila jobs-, a decline in domestic manufacturing employment, women's selection bias toward non-growth industries of the maquiladora plants, and a gender division of labor that limits (especially married) women´s participation (Fleck, 2001; Anderson and Dimon, 1998). Previous research has not focused on the change from less- to more skill-intensive maquiladoras. As the maquiladora industry has seen the arrival of new plants that require higher-skilled labor, industries like apparel manufacturing have contracted while electronic manufacturing have expanded, and so has the level employment in these industries. This is an important trend that must be investigated since it affects gender employment.

The movement towards or away from feminization is caused by a number of heterogeneous factors. Because of the diversity of the underlying components that affect the participation of women in the workforce, plant-level research is essential if one is to incorporate the diverse determinants of feminization (Ozler, 2000). This inclusion affords an opportunity to address questions that could not be investigated with cross-country or/and industry- level information alone. One example is the effects of size -- large vs. small firms-- on the patterns of female and male employment. The use of plant-level information also contributes to the elimination of erroneous results, since industry- level information is more likely to be misleading (Ozler, 2000). Since industry- level data provides information on net employment changes, a shuffle in female employment between large and small firms in the same industry would not be addressed as net employment at the industry level would reflect no change. Then it would appear that size does not have an impact on employment. Previous plant- level research on feminization of EOI in developing countries has found that plant- level data makes possible better control of the determinants of female labor participation (Ozler, 2000). The use of plant-level information takes into account the heterogeneity of plant characteristics, such as capital- intensity and size. Plant-level research across manufacturing industries is scarce given the difficulty of obtaining these data sets. An important contribution of this paper is to investigate female participation in the maquiladora workforce at the plant level.

Female labor participation has been associated with gender- earning differences. The degree of female participation in the workforce can affect the gender- wage gap. Previous research has found that feminization is necessary but not sufficient to eliminate gender wage differentials (Carraway, 2007). Women receive lowers wages than men in EOI, even when labor- supply characteristics are controlled for (Manning, 1998; Caraway, 2007). In the cases of

developing countries in Asia -- Indonesia, South Korea, Hong Kong, Singapore and Taiwan-- prior empirical results have shown that feminization in EOI has had mixed effects on gender inequality (Carraway, 2007). In some Asian countries the gender-based wage differences have diminished slightly, while in other countries they have widened. In addition, results for the same country have been found to be different, as in the case of Taiwan (Seguino, 1997; Berik, 2000). Past research into the gender-earnings gap for the maquiladoras at the industry level have used as explanatory variables female participation –line workers as a share of all production-line workers-, border employment as a share of all employment, plant size, capital intensity and time (Fleck, 2001). In prior studies, the gender-earnings gap is estimated as the ratio between women´s and men's real average hourly earnings (production-line workers). The aforementioned studies have found that a greater number of women in an industry in conjunction with an increase in capital intensity expand the gender- earnings gap, while location in non-border areas reduces it (Fleck, 2001).

Previous studies of EOI and feminization have focused primarily on labor-intensive and female-dominated industries, causing a difficulty in assessing whether export orientation and labor intensity are driving the use of female labor (Caraway, 2007). Therefore those studies were not able to demonstrate that industries that are capital-intensive and male- dominated produce different outcomes. This causes a methodological issue for studying feminization. This weakness is overcome by incorporating all the different maquiladora industries that have different levels of capital intensity. Also, previous research on the gender-earnings gap and its relationship to feminization for EOI has found limited and sometimes unreliable results given data limitations. The use of plant level data and the availability of labor- census data have helped to improve the results.

3.3 Overview of the Maquiladora Industry

3.3.1 The Maquiladora Industry

A maquiladora is a manufacturing establishment that assembles intermediate imported goods into export products. The semi-finished or finished goods can then be imported back to the U.S., where customs duties apply on the basis of the value added in Mexico. Through the years the maquiladora industry has evolved from low-skilled labor intensive plants, e.g. apparel manufacturing, to more advance manufacturing processes, e.g. electronic manufacturing. The evolution of the maquiladoras has been classified into three different stages.[23] First- stage plants are characterized as labor-intensive with low technology and high control by parent companies, for instance a textile plant. Second- stage plants are more skill-intensive, employ more technicians and engineers, and have moved from assembly to manufacturing, e.g. plants that manufacture auto harnesses, televisions, and electronic appliances. Third-stage maquiladoras are relatively skill-intensive, employing specialized technicians and engineers, developing patented products and eliminating technological reliance in a parent company; an example would be the development of sensor and brake systems for automobiles. This last stage has been observed only in a very small percentage of plants. The second stage is the overall development observed in the majority of the industry.

Before NAFTA maquiladoras could import duty free machinery, raw materials and intermediary inputs for manufacture, processing and assembly. With its implementation of in January, 2001, NAFTA required Mexico to eliminate duty-free imports from non-NAFTA countries. The changes are based on the rules of origin to satisfy the requirements of a minimum

[23] Cañas, Jesus; Coronado, Roberto. "Maquiladora Industry: Past, Present and Future" Federal Reserve Bank of Dallas El Paso Branch, 2002

percentage of North American content in goods traded between NAFTA countries. This forced the Mexican government to revise the regulations on the maquiladora industry and create a sectorial promotion program to protect the duty-free status of maquiladora imports that would reduce tariffs to their pre NAFTA levels. This measure in essence allowed the maquiladora program to continue.

As various regions around the world have adopted export oriented manufacturing programs, i.e. offering tax incentives and low wages, it has increased global competition to attract the establishment of foreign assembly plants. Maquila exports to the U.S. have been affected since 2001 by an increase in competition from countries with similar factor endowments as Mexico, especially from China. The effect has not been homogenous among all industries; sectors with a higher degree of low-skill, labor- intensive factor requirement relative to other industries have been the hardest hit, e.g. apparel manufacturing.

As suggested by the factor proportions framework countries like China will have a comparative advantage in the industry that produces goods that intensively uses the abundant factor. In this case, China has a greater abundance of low-skill labor than Mexico and when used in industries like apparel manufacturing Chinese exports to the U.S. have a comparative advantage vs. Maquila exports, hence displacing them in the U.S. market.

The maquiladoras can be competitive in manufactured products that require from medium to high skill intensive labor, were competition is based more on quality than price. Mexico´s proximity to the United States is another advantage for the maquiladoras in the global manufacturing landscape. Location allows the maquiladora to have an advantage in industries that: have a high ratio of weight over value; are characterized by frequent changes in design

specification; and maintain low inventories. An example is the auto industry, since autos are heavy and bulky that makes shipping an issue, there are frequent design changes on autos, and the practice of just-in-time inventories is a standard practice.

In 2007 a regulatory change is enacted that merges the maquiladora program with an export oriented program for resident companies known as the Program for Temporary Imports to Promote Exports (PITEX). Both programs were merged into a new program, the Maquiladora Manufacturing Industry and Export Services (IMMEX). As a result, INEGI stopped reporting maquiladora data after March 2007 and the information has been merged in to the IMMEX data.

The maquiladora industry has evolved from labor-intensive to more capital-intensive. Maquiladora plants that focus on assembly are now becoming less representative of the industry, while plants that are manufacturing oriented and that incorporate more capital and require higher labor skills are becoming the norm. Thus, the initial definition of a foreign assembly plant has less and less significance in the way maquiladoras are defined. So what is a maquiladora today? A maquiladora is considered a foreign firm that assembles, manufactures or provides services and operates under the maquiladora program from the Ministry of the Economy.

3.3.2 Historical Female Employment

The Mexican government enacted in 1965 the Border Industrialization Program (BIP). As an attempt by the Mexican government to mitigate the male unemployment caused by the termination of the Bracero farm labor program in the mid 60´s by the United States. Among the policies that were implemented to promote manufacturing investment was duty free import of machinery, raw materials and intermediary inputs for manufacture, processing and assembly.

With the condition that final manufactured products were then to be exported out of Mexico. This gave birth to the maquiladora plant, a manufacturing establishment that assembles intermediate imported goods into export products.

The male displaced workers coming back from the U.S. would be employed in the maquiladora plants located in the border regions. The employment of women in the early stages of the BIP was unexpected (Pearson, 2001). Women became the preferred source of labor since the beginning of the maquiladora program. The first maquiladora plants located in the border regions were characterized for being labor-intensive. In 1975, women maquiladoras workers represented nationwide 78.3% of the total production line workers and 60.8% of the total employees (See Table 1). By 1985 the participation of women had fallen to 69.0% and 56.6%, respectively (See Table 1). The fall in women´s share in employment during this period has been explained by three factors (Pearson, 2001): sectors that traditionally employed men increased – metal products, furniture and wood products and transportation- ; changes in the technology and organization of the manufacturing procedures causing a less reliance in less skilled manual workers; and by the decline in the supply of adequate women workers.

3.4 Data Description and Overview

3.4.1 Plant level data

Maquiladora industry information is from INEGI (Instituto Nacional Estadística y Geografía). A monthly survey is applied to the universe of maquiladoras. All maquiladora establishments/plants are obligated to comply with the filling out of the questionnaire for the Estadistica de la Industria Maquiladora de Exportacion (EIME). The observation unit for the Industry is a maquiladora establishment, or plant. The data includes information on: employees, salaries paid to employees, man-hours, days worked, inputs consumed, various expenditures,

Table 1 Maquiladora Historical Employment

Year	Employess	Proluction-line			Female/Production	Female/Employees	Technitians	Administrative
		Total	Male	Female				
1975								
National	69,318	53,771	11,653	42,118	0.78	0.61	9,569	5,978
1980								
National	119,546	102,020	23,140	78,880	0.77	0.66	10,828	6,698
Border Cities	106,303	91,038	21,455	69,583	0.76	0.65	9,626	5,639
1985								
National	211,968	173,874	53,832	120,042	0.69	0.57	25,042	13,052
Border Cities	186,000	152,819	50,195	102,624	0.67	0.55	22,313	10,868

Source: Estadistica de la Industria Maquiladora de Exportacion (EIME) INEGI and Secretaria de Programacion y Presupuesto .Authors Calculation.

gross profits and export value added of each maquiladora establishments. Total sales can be inputted by adding inputs consumed (domestic plus imported) plus export value added. The data does not include information on: own capital equipment or details on the type of ownership (by firm or foreign). The data set constructed for this study is a yearly unbalanced panel data set from 1990-2006 for eleven manufacturing maquiladora industries and one service industry. The data set contains 17 maquiladora cities (See Table 2 & 3). The 17 cities included are considered the major maquiladora establishment sites, given that these cities have been for years primary locations for the maquiladora industry, and include all border city regions where the maquiladora is located. The data set consist of 29,705 plant year observations that include 4,164 plants and 1,551 firms. The panel data set represents on average from 1990-2006, 73.1% of total employment and 73.4% of total export valued added for the maquiladora industry (See Graph 1 & 2). INEGI estimated the annual values from the monthly information, some series (salaries paid, man-hours, inputs consumed, various expenditures, gross profits and export value added) were added by year to obtain the annual values, while the remaining series (employees, days worked, and establishments) were averaged by year to obtain the annual values. Plants that answered the survey infrequently were eliminated, since no reliable series could be estimated. These plants are characterized for being small plants that are continuously entering and exiting the maquiladora program. Further characterization of non-responsive and removed plants is being pursued in correspondence with INEGI´s recommendations.

Table 2 The major maquiladora cities in Mexico

City	Location
Mexicali	Border
Tecate	Border
Tijuana	Border
Acuña	Border
Piedras	Border
Torreon	Non-Border
Chihuahua	Non-Border
Juarez	Border
DF & Edo de Mexico	Non-Border
Guadalajara	Non-Border
Guadalupe	Non-Border
Monterrey	Non-Border
Agua Prieta	Border
Nogales	Border
Matamoros	Border
Nuevo Laredo	Border
Reynosa	Border

Source: INEGI

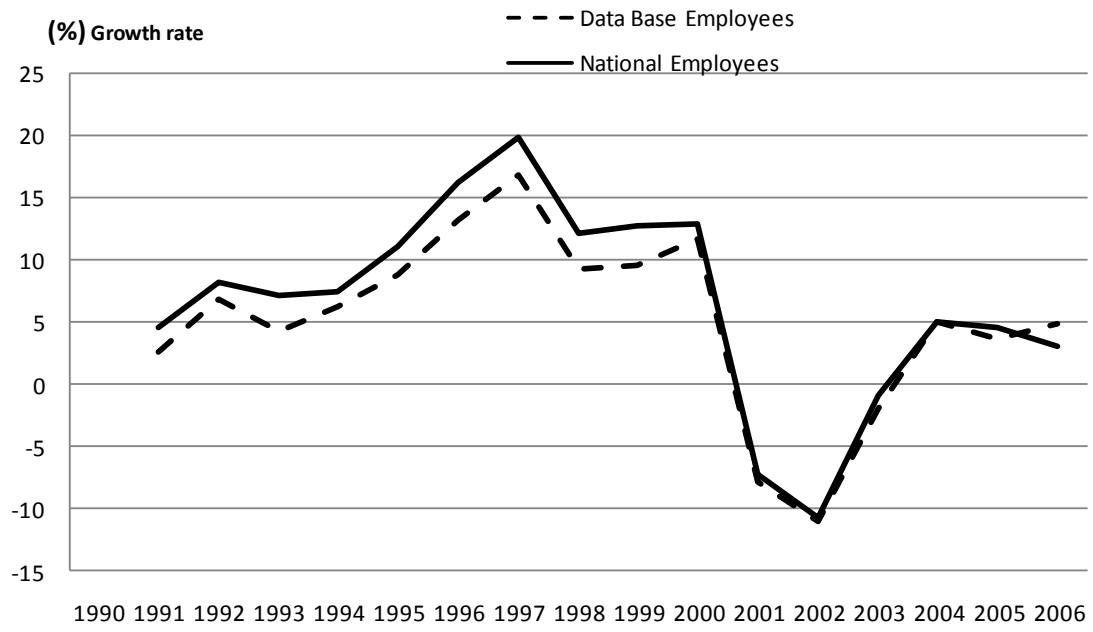
Table 3 Maquila Industry Descriptions

Description	NAICS Code
Selection, preparation, packing, and canning of food	3114
Apparel and texitle knitting and sewing	3151,3152,3159,3169
Footwear manufacturing and leather and hide tanning	3161,3162
Furtinure and other wood and metal products assembly	3323,3371,3379
Chemical products	33251,3252,3253,3254,3255,3256
Manufacturing, re-manufacturing and transportation(and	3362,3363,3369
Assembly and repair of tools, equipment and parts, except	3331,3332,3334,3339
Assembly of machinery and equipment electrical and	3341,3342,3343,3344,3345,3346,3352
Electronic and electric materials and accesories	3351,3353,3359
Sporting goods and toy assembly	3339920,339931,339932
Other manufacturing industries	334510,3391,3399,339992*
Services	541380, 561990, 5621, 2622, 5629, 8123

Source: Department of Exterior Commercial Statistics, Administrive and Pricing Registry, INEGI

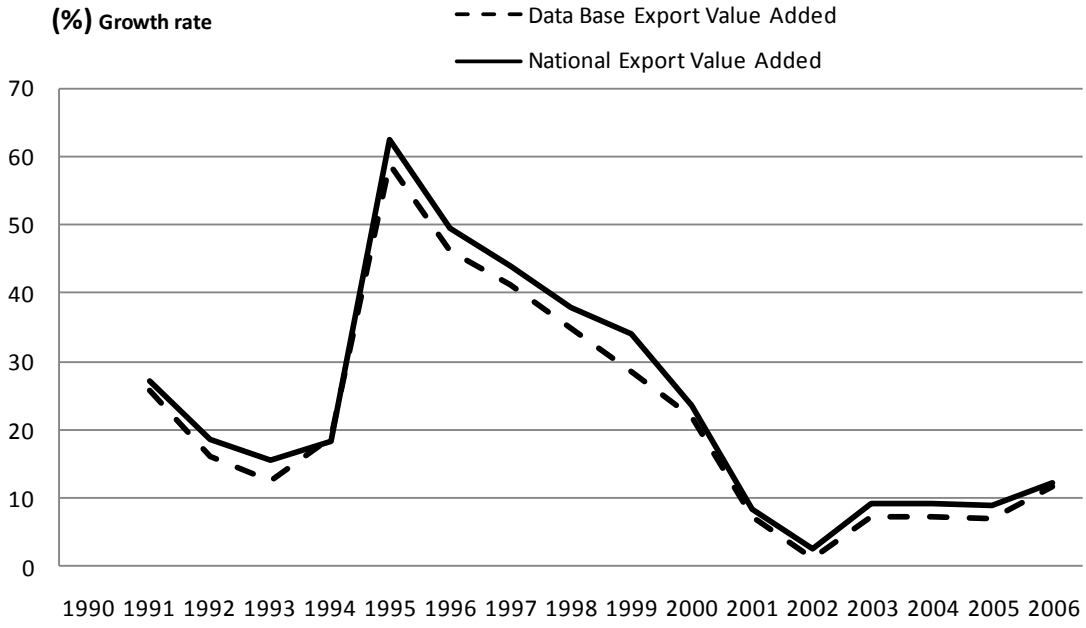
*/Excluding 339920-339931-339932

Graph 1 Employees: Maquila Industry Total and Aggregate Plant-level data



Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation

Graph 2 Export Value Added: Maquila Industry Total and Aggregate Plant-level data



Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation

3.4.2 Labor Supply

The labor supply information in this paper is drawn from INEGI´s population census. Contained in the census data is information by age and gender on the demographic characteristics – gender, education, civil status, children, migration, and housing - of the the labor supply characteristics by age and gender for all 17 maquiladora cities. The population census is performed every five years as a result the panel data series is reduced to 4 years – 1990, 1995, 2000 and 2005-, since no other information is available on labor supply characteristics by locality. In this paper the supply of labor is defined as women/men between the ages of 16 to 55 years. The designation of this age group is based on previous studies that found the average age of the female maquiladora worker to be 24 years (Liu V.; Sanchez-Monroy; Parga, 1999). The young age of female workers is a characteristic shared by EOI in developing countries around the world (Baslevent; Onaran, 2004). The labor supply data includes: years of schooling, number of children, marriage and migration status. Percentages are estimated for each labor supply characteristic by dividing the population characteristics for each age group by the corresponding total population age group. Thus, the percentages represent the female/male supply of labor: with 6 to 9 years of schooling; with children; married; and that has migrated from another state. This information is used to control for labor supply characteristics for each city where the maquiladora plant is located.

3.4.3 Feminization and Earnings

To estimate feminization in the maquiladora industry the number of women employees were divided by the total number of employees by classification. For worker employees the information by gender is available from 1990-2006. For all employees, as well for technicians and administrative employees, the information by gender is only available from 1997-2006.Thus,

Feminization by type of employee for industry i in year t,

$$Fratio_{cit} = \frac{female_{cit}}{employees_{cit}}$$

where, $female_{cit}$ is the number of female employees by classification c in industry i and in year t ; $employees_{cit}$ is the total number of employees by classification c in industry i and in year t. Employees are classified into: workers, technicians, administrative, and total. This variable is used to represents the ratio of female workers over total workers, where if the value is moving away from one through time then the industry is said to represent a defeminization trend and vice versa, if the value is moving closer to one through time then the industry is said to represent a feminization trend.

To estimate maquiladora hourly wages in constant pesos, total wages by employee classification were divided by total hours worked by each type of employee classification and total employee wages with benefits where divided by total employee hours worked. Then the nominal values were divided by the consumer price index estimated by Banco de Mexico in order to obtain real wages per employee. Also the nominal hourly wages in pesos where divided by the nominal exchange rate to convert the wages into dollar values. The nominal exchange rate used to convert peso figures into dollar values was the monthly average of the FIX exchange rate. This exchange rate is estimated by Banco de Mexico as the average wholesale market price for operations that will be completed the second working banking day.

Wages classified by gender are only available for the worker category from 1997-2006. There is no other wage information by gender. To calculate the gender wage ratio between female and male workers, the female wage per hour was divided by the male wage per hour.

Thus,

The wage ratio for industry i in year t,

$$Wratio_{it} = \frac{Wfemale_{it}}{Wmale_{it}}$$

where, $Wfemale_{it}$ is the female wage per hour in industry i and in year t, $Wmale_{it}$ is the male wage per hour in industry i and in year t. This variable is used to represents the wage earnings gap, where if the wage ratio is higher or/and equal to one there is no wage gap, but values below one there exists a wage gap.

3.4.4 The Decline in Female Participation and the Increase in Skill

The overall participation of women workers in all 12 industries has dropped from 50.1% in 1990 to 44.0% in 2005 (See Table 4). During the same period, plant skill intensity has increased, as the share of technicians to total employees went from being 10.5% in 1990 to 13.0% in 2005 (See Table 5). Industries that were highly feminized have seen the participation of women decline like food manufacturing, apparel, and the assembly of electrical and electronic devices. The decline in female participation has not been accompanied by a fall in the number of women workers, but by an increase in the number of male workers that has outpaced the growth rate of female workers. Only two industries register a fall in the number of female workers during this period: footwear; and sporting goods and toy assembly. In the case of the footwear industry the plant size and plant skill intensity has increased, accompanied by an increase in the number of male workers. In regard to the sporting good and toy assembly industry, the size and plant skill intensity has diminished through the years (See Table 5 & 6). The decline in women´s participation is due more to an overall contraction of the industry as the number of plants and the

Table 4 Female workers ratio by Industry

Industry	1990	1995	2000	2005	1990-2005(%)
All	0.50	0.49	0.45	0.44	-12.27
Selection, preparation, packing, and canning of food	0.56	0.47	0.36	0.35	-38.16
Apparel and texitle knitting and sewing	0.71	0.72	0.61	0.60	-16.21
Footwear manufacturing and leather and hide tanning	0.42	0.39	0.42	0.39	-7.82
Furtinure and other wood and metal products assembly	0.21	0.22	0.21	0.21	0.56
Chemical products	0.33	0.41	0.42	0.44	31.84
Manufacturing, re-manufacturing and transportation(and	0.39	0.38	0.36	0.41	3.50
Assembly and repair of tools, equipment and parts, except	0.24	0.23	0.21	0.32	31.69
Assembly of machinery and equipment electrical and electronic	0.58	0.57	0.56	0.50	-13.64
Electronic and electric materials and accesories	0.65	0.63	0.58	0.58	-10.38
Sporting goods and toy assembly	0.60	0.57	0.51	0.58	-3.36
Other manufacturing industries	0.49	0.47	0.43	0.44	-10.76
Services	0.50	0.49	0.35	0.36	-28.76

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Feminization= Female Workers/ Total Workers. Data presented is the plant average.

Table 5 Skill: Plant Characteristics by Industry

Industry	1990	1995	2000	2005	1990-2005(%)
All	0.10	0.10	0.12	0.13	24.07
Selection, preparation, packing, and canning of food	0.08	0.08	0.14	0.21	144.93
Apparel and texitle knitting and sewing	0.08	0.08	0.09	0.10	23.75
Footwear manufacturing and leather and hide tanning	0.08	0.11	0.10	0.13	68.37
Furtinure and other wood and metal products assembly	0.07	0.10	0.11	0.10	37.10
Chemical products	0.09	0.10	0.14	0.16	66.14
Manufacturing, re-manufacturing and transportation(and	0.14	0.13	0.13	0.14	1.27
Assembly and repair of tools, equipment and parts, except	0.12	0.11	0.13	0.19	61.58
Assembly of machinery and equipment electrical and	0.12	0.11	0.13	0.14	22.06
Electronic and electric materials and accesories	0.13	0.12	0.13	0.14	15.08
Sporting goods and toy assembly	0.11	0.07	0.11	0.09	-18.53
Other manufacturing industries	0.10	0.09	0.11	0.12	19.43
Services	0.11	0.10	0.12	0.12	15.02

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Skill= Technitians/ Total Employees. Data presented is the plant average.

Table 6 Size: Plant Characteristics by Industry

Industry	1990	1995	2000	2005	1990-2005(%)
All	283	315	398	410	45.14
Selection, preparation, packing, and canning of food	151	125	116	230	51.83
Apparel and texitle knitting and sewing	165	159	187	195	18.35
Footwear manufacturing and leather and hide tanning	194	202	204	392	101.85
Furtinure and other wood and metal products assembly	113	142	153	173	53.16
Chemical products	88	130	187	197	122.59
Manufacturing, re-manufacturing and transportation(and accesories) equipment assembly	790	928	1,101	964	22.06
Assembly and repair of tools, equipment and parts, except electrical	161	183	309	275	70.68
Assembly of machinery and equipment electrical and electronic devices	512	575	682	674	31.74
Electronic and electric materials and accesories	320	433	603	558	74.33
Sporting goods and toy assembly	432	257	348	200	-53.62
Other manufacturing industries	179	184	276	371	106.68
Services	246	231	236	157	-36.04

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Size= Total Employees. Data presented is the plant average.

Table 7 Age: Plant Characteristics by Industry

Industry	1995	2000	2005
All	3	5	7
Selection, preparation, packing, and canning of food	3	5	7
Apparel and texitle knitting and sewing	3	4	5
Footwear manufacturing and leather and hide tanning	4	7	9
Furtinure and other wood and metal products assembly	3	5	7
Chemical products	4	6	6
Manufacturing, re-manufacturing and transportation(and	4	6	8
Assembly and repair of tools, equipment and parts, except	4	6	7
Assembly of machinery and equipment electrical and	4	6	8
Electronic and electric materials and accesories	4	6	9
Sporting goods and toy assembly	3	5	7
Other manufacturing industries	3	5	7
Services	3	4	5

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Age= years in operation since 1990. Data presented is the plant average.

Table 8 Manufacturing Industry Mix with Employment Share(%) by City

City	1990	1995	2000	2005
Mexicali	1(1.81), 2(11.31), 4(5.63), 6(15.51), 7(7.04), 8(10.62), **9(30.38)**,10(3.89),11(13.81)	1(2.73), 2(10.40), 4(6.58), 5(1.60), 6(11.78), 7(6.67), 8(10.35), **9(28.65)**,10(8.57),11(12.68)	1(2.305), 2(3.49), 3(.57), 4(8.00), 5(1.88), 6 (10.42), 7(4.55), 8(10.39), **9(37.66)**,10(5.85),11(16.00)	1(1.34), 2(1.24),4(9.90), 5(2.27), 6(14.06), 7(3.83),8(21.12), **9(24.42)**,10(0.07),11(21.76)
Tecate	2(0.94), **4(45.86)**, 5(4.89),6(1.48), 7(2.71),9(33.97),11(10.15)	1(2.07), 2(1.07), **4(54.80)**, 5(5.73), 6(1.64), 7(1.08), 9(19.84),10(0.40),11(13.34)	1(0.47), 2(4.94),3(0.26), **4(40.19)**, 5(8.29),6(4.16), 7(0.50), 8(0.10),	1(0.70), 2(8.11), **4(44.76)**, 5(6.48),6(3.19), 7(0.38),8(0.42),9(16.41),
Tijuana	1(0.51), 2(4.08),3(.65), 4(15.34),5(4.15),6(1.57), 7(1.28),8(8.59),**9(39.27)**,	1(0.37), 2(3.74),3(1.12), 4(14.00),5(6.58),6(3.13), 7(0.67),8(6.17), **9(46.58)**,	1(0.35), 2(4.59),3(1.33), 4(13.14),5(7.11),6(2.99), 7(0.41),8(10.55), **9(41.64)**,	1(0.26), 2(4.40),3(1.69), 4(11.55),5(8.73),6(4.77), 7(1.39),8(13.76), **9(30.30)**,
Acuña	2(0.22),3(9.15), 4(0.89),**6(35.90)**, 7(0.41),8(17.73),9(13.07),	2(1.98),3(7.59), 4(7.04), **6(41.36)**, 7(1.07),8(10.18), 9(15.79), 10(1.43),11(13.61)	2(3.16),3(4.75), 4(0.06),5(0.11), **6(62.25)**, 7(1.52),8(9.82),9(8.25),	2(4.61),3(1.46), 4(0.96),5(0.83), **6(66.64)**, 7(0.83), 8(10.79),9(5.65),
Piedras	1(19.53), **2(33.06)**,3(1.33), 6(5.80), 8(6.07),9(16.04), 10(3.64),11(14.53)	1(4.76), 2(30.47), 3(0.432), 6(7.21), 8(15.37), **9(28.07)**,11(13.69)	1(0.46), 2(16.98), 3(0.37), 6(7.80), 8(19.83), **9(39.63)**, 11(14.93)	1(0.84), 2(0.37),3(1.47), 5(2.0), 6(10.37), 8(30.62), **9(37.34)**, 11(13.69)
Torreon	**2(59.19)**, 6(16.86), 11(23.95)	2(18.85),4(1.02), 5(0.08),6(31.17), 7(0.04),**8(38.53)**, 11(10.32)	**2(50.09)**,4(0.57), 5(0.10),6(35.84), 7(0.27),8(9.88), 9(0.11),11(3.16)	2(55.87), 4(0.01), 5(0.36), **6(32.99**), 7(0.89), 8(5.25),11(4.62)
Chihuahua	2(10.76),4(0.02), 5(0.20),**6(48.15)**,8(4.54), 9(33.70),11(2.64)	2(12.77),4(0.70), 5(0.32),**6(46.36)**, 7(0.63),8(7.70), 9(24.68),11(6.83)	2(11.36),4(2.12), 5(0.37),**6(44.09)**, 7(1.58),8(3.63), 9(30.92),11(5.94)	2(2.97),3(0.66), 4(2.52), 5(0.22), **6(45.35)**, 7(1.63),8(4.44), 9(32.83),11(9.38)
Juarez	1(0.34), 2(7.58),3(1.01), 4(6.54),5(2.10), **6(35.35)**, 7(0.63),8(9.47),	1(0.55), 2(6.13),3(0.30), 4(3.75),5(2.21),**6(34.14)**, 7(0.37),8(9.19),	1(0.54), 2(3.80),3(0.24), 4(2.13), 5(1.68), **6(39.25)**, 7(0.51), 8(8.69),	1(1.33), 2(1.07),3(0.15), 4(2.05),5(1.06), **6(41.37)**, 7(0.50),8(9.18), 9(28.14),
DF & Edo de Mexico	2(46.17),4(6.78), 8(16.77), **9(33.70)**,11(30.28)	1(0.37), **2(76.85)**,4(4.41),8(4.69), 9(0.30),11(13.38)	1(0.07), **2(72.20)**,3(1.11), 4(1.69), 5(3.98), 6(0.01), 7(0.44), 8(7.98),11(12.53)	1(0.11), **2(34.90)**,3(2.01), 4(2.59), 5(25.79), 6(1.34), 7(0.09), 8(29.26),11(3.91)
Guadalajara	2(0.06),3(7.61), 4(1.56), 5(0.43),6(6.08),8(42.82), **9(34.98)**,11(6.47)	2(13.53),3(14.51), 4(15.13),6(4.77), **8(23.22)**, 9(20.92),11(19.96)	2(26.39),3(1.06), 4(2.51), 5(0.38),6(2.37),**8(42.55)**, 9(29.43),11(13.46)	2(7.69), 5(0.44),6(0.97),7(0.05), **8(11.29)**, 9(8.34),11(1.57)
Guadalupe	1(6.18), 2(0.61), 4(5.29), 5(0.74),**6(71.65)**,8(0.70), 9(12.20),11(2.64)	1(2.24), 4(0.20), 5(0.48)**,** **6(45.14)**,8(9.81), 9(40.36),11(1.77)	1(1.15), 4(1.14), 5(0.46),6(26.19),8(18.35), **9(51.63)**,11(1.08)	4(3.45), 5(1.47),6(26.92),**8(30.14)**, 9(29.23),11(11.78)
Monterrey	2(8.04), 3(0.82),4(11.11), 8(18.84), 11(61.18)	2(7.31), 4(15.40), 5(0.08), **11(77.22)**	2(15.56), 4(3.32), 5(0.32), 8(2.14), **11(78.67)**	2(20.45), 4(10.06), 8(8.19), **11(61.29)**
Agua Prieta	2(12.05),4(0.73), 5(0.53), 6(31.62), 7(0.29), 8(1.81), **9(41.13)**, 11(11.84)	2(9.02),4(2.00), 5(0.46), 6(33.54), 7(1.08), 8(0.18), **9(43.91)**, 11(9.81)	2(10.16),4(1.90), 5(0.33), **6(40.94)**, 7(1.44), 8(0.44), 9(23.68), 11(21.11)	2(5.09),4(1.03), 6(26.94), 7(0.93), 8(2.07), 9(16.78), **11(47.16)**
Nogales	2(10.16), 3(1.12), 4(0.14), 5(0.14), 6(6.57), 7(2.58), 8(4.60), **9(58.86)**, 11(14.82)	2(9.10), 3(1.01), 4(0.13), 5(0.18), 6(7.57), 7(3.95), 8(2.75), **9(55.86)**, 10(0.03),	1(0.10), 2(4.47), 3(0.44), 4(0.34), 5(0.74), 6(7.99), 7(5.88), 8(3.89), **9(49.53)**,	1(0.22), 2(4.32), 4(0.81), 5(2.10), 6(5.10), 7(5.32), 8(2.42), **9(54.06)**, 10(0.16),
Matamoros	1(1.93), 2(0.27), 3(0.04), 4(1.02), 5(0.57), **6(33.90)**, 7(2.11), 8(29.64), 9(18.72),	1(1.14), 2(1.61), 4(1.02), 5(0.57), **6(33.90)**, 7(2.11), 8(29.64), 9(18.72), 11(7.10)	1(0.54), 2(3.20), 4(1.97), 5(2.05), 6(27.44), 7(2.69), 8(14.18), **9(32.28)**, 11(15.65)	1(0.46), 2(3.24), 4(3.41), 5(2.91), **6(38.13)**, 7(0.89), 8(9.63), 9(22.23), 11(19.11)
Nuevo Laredo	3(12.82), 4(3.18), 5(2.64), **6(41.77)**, 8(1.25), 9(13.03),10(0.52), 11(24.78)	3(6.93), 4(2.40), 5(2.68), **6(51.41)**, 8(1.54), 9(11.11), 11(23.93)	2(1.00), 3(3.13), 4(1.47), 5(4.48), **6(45.46)**, 7(0.37), 8(1.90), 9(19.32), 10(1.20),	4(4.70), 5(6.26), **6(48.34)**, 7(0.69), 8(1.78), 9(16.82), 10(0.72), 11(20.59)
Reynosa	1(2.12), 2(4.00), 3(5.53), 4(2.09), 5(0.60), 6(19.72), 7(2.99), **8(47.10)**, 9(12.50), 11(3.33)	1(0.03), 2(4.02), 3(2.28), 4(9.15), 5(1.37), 6(28.89), 7(3.12), **8(32.21)**, 9(13.53),10(0.12), 11(4.28)	2(4.52), 3(1.19), 4(7.74), 5(2.70), 6(22.08), 7(5.23), 8(17.59), **9(27.02)**,10(0.07), 11(11.85)	1(0.63), 2(2.19), 3(0.38), 4(6.91), 5(4.80), 6(16.99), 7(8.41), 8(16.84), **9(26.41)**,10(0.05), 11(16.40)

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Industry Share= Total Employment industry i, city j and year t / Total Employment City j and year t.

Data presented is the plant average.

participation of women: chemicals; transportation equipment and the assembly of tools, equipment and parts. This are considered non-traditional women industries. Interestingly, the feminization trend in all three industries has been accompanied with an increase in plant size and average plant skill intensity. When comparing the maquiladora service plants versus the manufacturing plants both have seen a fall in the ratio of female workers over total workers. This fall in the participation of women in the service industries has been accompanied by a small increase in the skill level and a decrease in size of the plants. The service plants also have one of the lowest plant ages (See Table 7).

The female worker ratios for each city are heterogeneous as a result of the industry mix (See Table 8) and the labor supply characteristics of each region. There are some cities like Chihuahua and Guadalajara where the average female participation rate (See Table 9) is between 53 to 67 percent from 1990-2005. In both cities, the traditional feminized industries are present and also the non-traditional ones that have seen an important increase in the participation of women workers. Guadalajara has been one of the cities with the highest female worker ratio and also one of two cities that have seen the number of women in the workforce decline through the years, the other city is Mexico City. The decline in the number of female workers is due to a contraction in the size (See Table 10) and the number of plants and not by an increase in the number of male versus female workers. In contrast, there are other cities like Acuña and Nuevo Laredo where the female worker ratio have been much lower between 38 to 47 percent. In both cities, there is a presence of industries like transportation manufacturing that is characterized for having a higher participation of male workers. Also, the age of the plants located in both cities is one of the highest (See Table 11). The inverse relationship between feminization and plant skill intensity is present for all four cities, where the plant skill intensity for Chihuahua and

Table 9 Female workers ratio rates by City

City	1990	1995	2000	2005	1990-2005(%)
All	0.50	0.49	0.45	0.44	-12.27
Mexicali	0.59	0.57	0.50	0.49	-16.51
Tecate	0.47	0.44	0.45	0.41	-13.31
Tijuana	0.46	0.45	0.41	0.41	-10.88
Acuña	0.43	0.45	0.37	0.38	-11.17
Piedras	0.47	0.53	0.49	0.46	-1.71
Torreon	0.69	0.60	0.46	0.40	-41.66
Chihuahua	0.67	0.62	0.52	0.53	-20.55
Juarez	0.48	0.48	0.45	0.46	-3.84
DF & Edo de Mexico	0.63	0.65	0.42	0.39	-37.39
Guadalajara	0.67	0.61	0.58	0.61	-8.19
Guadalupe	0.44	0.63	0.54	0.53	21.06
Monterrey	0.51	0.64	0.61	0.53	2.96
Agua Prieta	0.53	0.55	0.50	0.47	-11.25
Nogales	0.45	0.43	0.44	0.43	-5.16
Matamoros	0.59	0.58	0.50	0.47	-20.84
Nuevo Laredo	0.47	0.43	0.41	0.38	-17.41
Reynosa	0.49	0.46	0.48	0.44	-10.23

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Feminization= Female Workers/ Total Workers. Data presented is the plant average.

Table 10 Size: Plant Characteristics by City

City	1990	1995	2000	2005	1990-2005(%)
All	283	315	398	410	45.14
Mexicali	192	196	323	400	108.34
Tecate	69	98	92	79	13.70
Tijuana	146	185	244	275	87.79
Acuña	384	474	675	653	69.89
Piedras	185	257	427	309	66.76
Torreon	117	284	485	394	236.50
Chihuahua	572	375	560	575	0.54
Juarez	492	608	790	755	53.47
DF & Edo de Mexico	120	160	167	75	-37.41
Guadalajara	195	140	128	55	-71.97
Guadalupe	211	405	1,051	445	110.93
Monterrey	105	187	296	98	-6.55
Agua Prieta	246	324	236	301	22.11
Nogales	305	333	434	332	8.67
Matamoros	419	407	537	427	1.97
Nuevo Laredo	318	419	474	517	62.62
Reynosa	439	475	532	647	47.52

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Size= Total Employees. Data presented is the plant average.

Table 11 Age: Plant Characteristics by City

City	1995	2000	2005
All	3	5	7
Mexicali	4	5	8
Tecate	3	5	6
Tijuana	3	5	7
Acuña	4	7	9
Piedras	4	7	9
Torreon	2	4	6
Chihuahua	3	5	7
Juarez	4	6	8
DF & Edo de Mexico	2	3	4
Guadalajara	3	4	5
Guadalupe	3	7	6
Monterrey	3	3	6
Agua Prieta	4	8	10
Nogales	4	6	6
Matamoros	4	6	8
Nuevo Laredo	4	7	10
Reynosa	3	5	6

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.
Age= years in operation since 1990. Data presented is the plant average.

Table 12 Skill: Plant Characteristics by City

City	1990	1995	2000	2005	1990-2005(%)
All	0.10	0.10	0.12	0.13	24.07
Mexicali	0.12	0.12	0.13	0.16	36.51
Tecate	0.08	0.09	0.10	0.10	19.31
Tijuana	0.08	0.08	0.10	0.11	35.19
Acuña	0.10	0.10	0.12	0.14	37.76
Piedras	0.11	0.11	0.12	0.10	-0.68
Torreon	0.07	0.09	0.12	0.14	106.47
Chihuahua	0.12	0.11	0.13	0.16	30.46
Juarez	0.12	0.12	0.14	0.16	30.80
DF & Edo de Mexico	0.13	0.12	0.10	0.13	1.14
Guadalajara	0.12	0.07	0.10	0.14	17.39
Guadalupe	0.12	0.14	0.14	0.10	-17.41
Monterrey	0.11	0.09	0.11	0.12	3.35
Agua Prieta	0.15	0.13	0.14	0.14	-0.89
Nogales	0.13	0.11	0.13	0.12	-2.42
Matamoros	0.11	0.12	0.12	0.12	15.50
Nuevo Laredo	0.12	0.13	0.18	0.16	28.63
Reynosa	0.11	0.12	0.13	0.14	22.66

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Skill= Technitians/ Total Employees. Data presented is the plant average.

Table 13. Labor Supply Characteristics by Border City: (%) of Population between the ages of 16 to 55

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Mexicali	16-25	0.50	0.50	0.51	0.51	0.50	0.50	0.49	0.49
	26-35	0.49	0.50	0.50	0.50	0.51	0.50	0.50	0.50
	36-55	0.49	0.49	0.49	0.50	0.51	0.51	0.51	0.50
Tecate	16-25	0.51	0.51	0.50	0.52	0.49	0.49	0.50	0.48
	26-35	0.50	0.51	0.51	0.55	0.50	0.49	0.49	0.45
	36-55	0.50	0.51	0.51	0.55	0.50	0.49	0.49	0.45
Tijuana	16-25	0.51	0.50	0.50	0.50	0.49	0.50	0.50	0.50
	26-35	0.50	0.51	0.51	0.50	0.50	0.49	0.49	0.50
	36-55	0.49	0.50	0.50	0.51	0.51	0.50	0.50	0.49
Acuña	16-25	0.50	0.51	0.52	0.50	0.50	0.49	0.48	0.50
	26-35	0.48	0.50	0.52	0.50	0.52	0.50	0.48	0.50
	36-55	0.49	0.49	0.50	0.50	0.51	0.51	0.50	0.50
Piedras	16-25	0.49	0.49	0.50	0.49	0.51	0.51	0.50	0.51
	26-35	0.49	0.49	0.49	0.50	0.51	0.51	0.51	0.50
	36-55	0.49	0.49	0.49	0.50	0.51	0.51	0.51	0.50
Juarez	16-25	0.50	0.51	0.52	0.51	0.50	0.49	0.48	0.49
	26-35	0.49	0.50	0.51	0.51	0.51	0.50	0.49	0.49
	36-55	0.48	0.48	0.49	0.50	0.52	0.52	0.51	0.50
Agua Prieta	16-25	0.51	0.51	0.50	0.50	0.49	0.49	0.50	0.50
	26-35	0.48	0.50	0.51	0.50	0.52	0.50	0.49	0.50
	36-55	0.50	0.50	0.50	0.51	0.50	0.50	0.50	0.49
Nogales	16-25	0.52	0.52	0.51	0.50	0.48	0.48	0.49	0.50
	26-35	0.50	0.51	0.52	0.51	0.50	0.49	0.48	0.49
	36-55	0.49	0.50	0.51	0.51	0.51	0.50	0.49	0.49
Matamoros	16-25	0.48	0.48	0.49	0.49	0.52	0.52	0.51	0.51
	26-35	0.49	0.49	0.49	0.48	0.51	0.51	0.51	0.52
	36-55	0.48	0.48	0.49	0.49	0.52	0.52	0.51	0.51
Nuevo Laredo	16-25	0.49	0.50	0.50	0.50	0.51	0.50	0.50	0.50
	26-35	0.48	0.49	0.51	0.50	0.52	0.51	0.49	0.50
	36-55	0.47	0.48	0.49	0.50	0.53	0.52	0.51	0.50
Reynosa	16-25	0.49	0.49	0.49	0.50	0.51	0.51	0.51	0.50
	26-35	0.49	0.49	0.49	0.50	0.51	0.51	0.51	0.50
	36-55	0.48	0.49	0.49	0.50	0.52	0.51	0.51	0.50

Source: INEGI Census. Authors Calculation.

% Population = Men and/or Women 16 to 55 years of age/Population 16 to 55 years of age.

Table 14. Labor Supply Characteristics by Non-Border City: (%) of Population between the ages of 16 to 55

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Torreon	16-25	0.48	0.49	0.49	0.50	0.52	0.51	0.51	0.50
	26-35	0.47	0.47	0.47	0.48	0.53	0.53	0.53	0.52
	36-55	0.48	0.48	0.47	0.47	0.52	0.52	0.53	0.53
Chihuahua	16-25	0.48	0.49	0.49	0.50	0.52	0.51	0.51	0.50
	26-35	0.47	0.47	0.47	0.48	0.53	0.53	0.53	0.52
	36-55	0.48	0.47	0.47	0.47	0.52	0.53	0.53	0.53
DF & Edo de Mexico	16-25	0.48	0.48	0.48	0.49	0.52	0.52	0.52	0.51
	26-35	0.48	0.48	0.48	0.47	0.52	0.52	0.52	0.53
	36-55	0.48	0.48	0.47	0.47	0.52	0.52	0.53	0.53
Guadalajara	16-25	0.47	0.48	0.49	0.49	0.53	0.52	0.51	0.51
	26-35	0.46	0.46	0.47	0.47	0.54	0.54	0.53	0.53
	36-55	0.46	0.46	0.46	0.45	0.54	0.54	0.54	0.55
Guadalupe	16-25	0.50	0.50	0.50	0.51	0.50	0.50	0.50	0.49
	26-35	0.49	0.49	0.49	0.49	0.51	0.51	0.51	0.51
	36-55	0.50	0.50	0.49	0.49	0.50	0.50	0.51	0.51
Monterrey	16-25	0.51	0.51	0.50	0.50	0.49	0.49	0.50	0.50
	26-35	0.49	0.50	0.50	0.50	0.51	0.50	0.50	0.50
	36-55	0.48	0.48	0.48	0.48	0.52	0.52	0.52	0.52

Source: INEGI Census. Authors Calculation.

% Population = Men and/or Women 16 to 55 years of age/Population 16 to 55 years of age.

Guadalajara is one of the lowest, and for Acuña and Nuevo Laredo is one of the highest (see Table 12).

When observing the labor supply characteristics of the maquiladora cities from 1990 to 2005, in twelve of them the number of women between the ages of 16 to 55 years is greater than the number of men (See Table 13 & 14). The rest of the five cities where the male population is greater share a common characteristic, all of them are located along the Mexico-US border. As would be expected, cities that have a larger female population have a greater female worker ratio in the maquiladora plants and cities with a larger male population have a lower female worker ratio. This is especially true if the female population is more concentrated between the ages of 16-35 versus the male as these are the prime years to be a maquiladora employee. Education differences between men and women for the 16-55 age groups are small, in twelve cities a greater percentage of the male population has between 6 to 9 years of formal education, relative to the female population, while the remaining five cities where the female percentage is higher all of them are border cities (See Table 15 & 16). When observing the education levels by age group the female population between the ages of 16-25 are found to have overall a lower level education versus the males, but then the differences are eliminated as the population gets older. This is an important characteristic since the maquiladora employs younger individuals.

Examining the female education differences by city, the border cities are found to have the higher rates of the female population with at least 6 to 9 years of formal education versus the non-border cities (See Table 15 & 16). This is true for all age groups. Cities like Acuña and Laredo have higher percentages of education that accompanied with lower female worker ratio,

Table 15. Labor Supply Characteristics by Border City: (%) of Population between the ages of 16 to 55 with 6 to 9 years of education.

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Mexicali	16-25	0.51	0.49	0.48	0.44	0.46	0.46	0.46	0.42
	26-35	0.40	0.44	0.48	0.47	0.43	0.45	0.47	0.47
	36-55	0.38	0.39	0.41	0.43	0.41	0.43	0.46	0.46
Tecate	16-25	0.57	0.56	0.56	0.47	0.53	0.53	0.52	0.46
	26-35	0.46	0.50	0.53	0.52	0.49	0.51	0.53	0.51
	36-55	0.39	0.42	0.45	0.46	0.41	0.45	0.49	0.47
Tijuana	16-25	0.57	0.56	0.55	0.49	0.55	0.55	0.54	0.48
	26-35	0.46	0.49	0.52	0.51	0.49	0.52	0.54	0.53
	36-55	0.42	0.43	0.45	0.47	0.43	0.46	0.50	0.50
Acuña	16-25	0.62	0.65	0.67	0.63	0.63	0.65	0.67	0.63
	26-35	0.47	0.54	0.60	0.64	0.49	0.55	0.61	0.65
	36-55	0.38	0.43	0.48	0.54	0.36	0.41	0.46	0.54
Piedras	16-25	0.57	0.58	0.60	0.55	0.54	0.56	0.57	0.53
	26-35	0.48	0.51	0.55	0.55	0.51	0.53	0.55	0.57
	36-55	0.41	0.45	0.48	0.50	0.42	0.46	0.51	0.52
Juarez	16-25	0.58	0.59	0.60	0.52	0.60	0.60	0.59	0.51
	26-35	0.48	0.52	0.55	0.56	0.55	0.58	0.60	0.60
	36-55	0.42	0.45	0.48	0.50	0.45	0.49	0.53	0.56
Agua Prieta	16-25	0.55	0.56	0.57	0.54	0.55	0.56	0.57	0.54
	26-35	0.52	0.53	0.54	0.59	0.54	0.55	0.56	0.59
	36-55	0.45	0.48	0.50	0.52	0.49	0.51	0.53	0.56
Nogales	16-25	0.57	0.55	0.53	0.48	0.55	0.54	0.52	0.47
	26-35	0.51	0.51	0.51	0.52	0.57	0.55	0.54	0.53
	36-55	0.48	0.49	0.50	0.51	0.51	0.54	0.56	0.56
Matamoros	16-25	0.51	0.52	0.54	0.46	0.54	0.54	0.54	0.46
	26-35	0.46	0.48	0.50	0.50	0.50	0.52	0.55	0.55
	36-55	0.37	0.40	0.44	0.46	0.37	0.42	0.48	0.50
Nuevo Laredo	16-25	0.51	0.53	0.54	0.49	0.52	0.53	0.55	0.49
	26-35	0.47	0.49	0.51	0.52	0.50	0.51	0.52	0.55
	36-55	0.41	0.43	0.45	0.46	0.42	0.45	0.48	0.49
Reynosa	16-25	0.53	0.53	0.53	0.47	0.53	0.54	0.54	0.47
	26-35	0.45	0.47	0.49	0.48	0.47	0.50	0.53	0.52
	36-55	0.37	0.40	0.43	0.44	0.37	0.41	0.45	0.48

Source: INEGI Census. Authors Calculation.

Education % Population = Men and/or Women 16 to 55 years of age with 6 to 9 years of education/Population Men and/or Women 16 to 55 years of age.

Table 16. Labor Supply Characteristics by Non-Border City: (%) of Population between the ages of 16 to 55 with 6 to 9 years of education.

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Torreon	16-25	0.45	0.45	0.46	0.39	0.46	0.45	0.45	0.38
	26-35	0.39	0.40	0.42	0.43	0.44	0.44	0.43	0.45
	36-55	0.41	0.40	0.40	0.39	0.45	0.45	0.46	0.44
Chihuahua	16-25	0.49	0.47	0.46	0.37	0.48	0.46	0.45	0.35
	26-35	0.41	0.44	0.47	0.46	0.48	0.48	0.49	0.47
	36-55	0.43	0.43	0.42	0.43	0.49	0.50	0.50	0.48
DF & Edo de Mexico	16-25	0.49	0.50	0.50	0.43	0.46	0.46	0.46	0.40
	26-35	0.44	0.46	0.47	0.46	0.44	0.45	0.46	0.45
	36-55	0.41	0.43	0.45	0.45	0.38	0.41	0.44	0.45
Guadalajara	16-25	0.52	0.51	0.50	0.41	0.48	0.48	0.47	0.37
	26-35	0.42	0.45	0.47	0.46	0.46	0.47	0.48	0.45
	36-55	0.41	0.42	0.43	0.44	0.43	0.46	0.48	0.48
Guadalupe	16-25	0.52	0.51	0.50	0.43	0.48	0.48	0.48	0.41
	26-35	0.42	0.45	0.47	0.45	0.47	0.46	0.46	0.44
	36-55	0.42	0.43	0.44	0.43	0.44	0.46	0.48	0.46
Monterrey	16-25	0.43	0.44	0.45	0.42	0.41	0.43	0.44	0.42
	26-35	0.38	0.40	0.43	0.45	0.40	0.41	0.41	0.44
	36-55	0.39	0.38	0.38	0.40	0.43	0.42	0.41	0.41

Source: INEGI Census. Authors Calculation.

Education % Population = Men and/or Women 16 to 55 years of age with 6 to 9 years of education/Population Men and/or Women 16 to 55 years of age.

an inverse relationship is found between feminization and education. The opposite is true for cities like Chihuahua and Guadalajara that have lower education percentages but have higher female worker rates. The negative relationship between feminization and education is surprising and suggest that education may be a threshold variable where employers seek a minimal level of education, this could be especially true for female workers. Previous studies have found a similar relationship between feminization and education (Carraway, 2007). Overall, education levels increased from 1990-2005, with the exception of five non-border cities and one border city. In regard to marriage and fertility, the percentage of the female population that is married has declined versus the male population (See Table 17 & 18), while the percentage of the female population with children has increased (See Table 19 & 20). When looking at the population that is married by age group, the female population between the ages of 16 to 25 years that is married is greater than the male population. This effects the decision to enter the labor force by females in this age group. The non-border cities have seen a greater decrease in the overall number of people that are married versus the border cities. In regard to fertility, cities like Acuña and Nuevo Laredo have a greater percentage of the female population with children versus Chihuahua and Guadalajara who have a lower percentage but with a higher female worker ratio (See Table 19 & 20). Unfortunately there is no information available on male fertility. In the question of migration, there has been a decrease in the percentage of the population that has migrated from other regions to these maquiladora cities (See Table 21 & 22). A high percentage of the population that has migrated to these cities is found to be young individuals –male and female-, between the ages of 16 to 25 years. The migration of a younger population is possible related to job opportunities in the maquiladora industry. There are no major gender differences in the percentages of the population that has migrated from other regions to these cities.

Table 17. Labor Supply Characteristics by Border City: (%) of Population between the ages of 16 to 55 Married

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Mexicali	16-25	0.17	0.16	0.14	0.15	0.28	0.26	0.24	0.26
	26-35	0.62	0.57	0.52	0.55	0.66	0.62	0.58	0.64
	36-55	0.76	0.71	0.67	0.69	0.69	0.66	0.62	0.65
Tecate	16-25	0.19	0.18	0.17	0.17	0.32	0.30	0.27	0.30
	26-35	0.64	0.59	0.53	0.56	0.69	0.64	0.59	0.66
	36-55	0.75	0.70	0.65	0.68	0.70	0.67	0.63	0.66
Tijuana	16-25	0.18	0.16	0.14	0.15	0.29	0.26	0.23	0.27
	26-35	0.61	0.55	0.48	0.51	0.64	0.59	0.53	0.62
	36-55	0.74	0.69	0.63	0.66	0.67	0.62	0.58	0.62
Acuña	16-25	0.28	0.27	0.26	0.26	0.39	0.39	0.39	0.34
	26-35	0.73	0.66	0.60	0.63	0.72	0.67	0.62	0.70
	36-55	0.81	0.76	0.72	0.74	0.73	0.70	0.66	0.69
Piedras	16-25	0.27	0.26	0.24	0.25	0.37	0.35	0.34	0.30
	26-35	0.74	0.69	0.64	0.67	0.74	0.70	0.66	0.70
	36-55	0.84	0.80	0.76	0.78	0.76	0.72	0.69	0.70
Juarez	16-25	0.20	0.18	0.16	0.17	0.29	0.27	0.25	0.29
	26-35	0.65	0.59	0.52	0.55	0.65	0.60	0.56	0.65
	36-55	0.77	0.72	0.67	0.69	0.67	0.63	0.60	0.64
Agua Prieta	16-25	0.15	0.14	0.14	0.14	0.24	0.24	0.23	0.29
	26-35	0.57	0.51	0.46	0.49	0.60	0.55	0.50	0.66
	36-55	0.73	0.67	0.61	0.64	0.66	0.61	0.56	0.64
Nogales	16-25	0.16	0.16	0.17	0.16	0.27	0.27	0.26	0.31
	26-35	0.60	0.55	0.50	0.53	0.62	0.58	0.55	0.66
	36-55	0.75	0.70	0.65	0.68	0.65	0.62	0.58	0.63
Matamoros	16-25	0.20	0.19	0.18	0.18	0.30	0.28	0.27	0.28
	26-35	0.67	0.63	0.59	0.61	0.65	0.62	0.59	0.65
	36-55	0.78	0.74	0.70	0.72	0.69	0.65	0.62	0.65
Nuevo Laredo	16-25	0.21	0.21	0.21	0.21	0.30	0.31	0.31	0.28
	26-35	0.69	0.64	0.59	0.62	0.68	0.65	0.62	0.66
	36-55	0.81	0.76	0.71	0.74	0.70	0.67	0.63	0.66
Reynosa	16-25	0.21	0.20	0.19	0.19	0.33	0.31	0.28	0.30
	26-35	0.72	0.67	0.62	0.64	0.72	0.67	0.62	0.65
	36-55	0.83	0.79	0.74	0.77	0.74	0.70	0.65	0.65

Source: INEGI Census. Authors Calculation.

Married % Population =

Married Men and/or Women 16 to 55 years of age/Population Men and/or Women 16 to 55 years of age.

Table 18. Labor Supply Characteristics by Non-Border City: (%) of Population between the ages of 16 to 55 Married

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Torreon	16-25	0.21	0.21	0.20	0.21	0.30	0.29	0.29	0.21
	26-35	0.72	0.69	0.65	0.67	0.71	0.68	0.64	0.61
	36-55	0.83	0.81	0.78	0.79	0.72	0.70	0.68	0.66
Chihuahua	16-25	0.19	0.17	0.16	0.17	0.28	0.25	0.23	0.20
	26-35	0.73	0.67	0.61	0.64	0.71	0.67	0.62	0.63
	36-55	0.85	0.81	0.78	0.79	0.75	0.71	0.67	0.65
DF & Edo de Mexico	16-25	0.16	0.19	0.21	0.20	0.26	0.20	0.14	0.19
	26-35	0.65	0.61	0.56	0.58	0.66	0.60	0.55	0.55
	36-55	0.82	0.73	0.63	0.68	0.70	0.72	0.74	0.63
Guadalajara	16-25	0.16	0.16	0.16	0.16	0.25	0.24	0.24	0.14
	26-35	0.69	0.65	0.60	0.63	0.67	0.63	0.60	0.47
	36-55	0.86	0.82	0.79	0.81	0.72	0.69	0.66	0.58
Guadalupe	16-25	0.31	0.26	0.20	0.23	0.20	0.25	0.30	0.14
	26-35	0.79	0.73	0.68	0.71	0.77	0.74	0.71	0.57
	36-55	0.82	0.83	0.83	0.83	0.89	0.82	0.76	0.72
Monterrey	16-25	0.26	0.22	0.17	0.20	0.17	0.22	0.26	0.15
	26-35	0.68	0.64	0.59	0.61	0.66	0.64	0.63	0.51
	36-55	0.76	0.77	0.77	0.77	0.85	0.77	0.70	0.65

Source: INEGI Census. Authors Calculation.

Married % Population =

Married Men and/or Women 16 to 55 years of age/Population Men and/or Women 16 to 55 years of age.

Table 19. Labor Supply Characteristics by Border City: (%) of Female Population between the ages of 16 to 55 with Children

City	Age	Female			
		1990	1995	2000	2005
Mexicali	16-25	0.34	0.34	0.34	0.38
	26-35	0.82	0.82	0.82	0.80
	36-55	0.90	0.90	0.90	0.91
Tecate	16-25	0.39	0.39	0.39	0.40
	26-35	0.84	0.84	0.84	0.82
	36-55	0.90	0.90	0.90	0.91
Tijuana	16-25	0.37	0.37	0.37	0.39
	26-35	0.81	0.81	0.81	0.80
	36-55	0.91	0.91	0.91	0.91
Acuña	16-25	0.40	0.40	0.40	0.51
	26-35	0.85	0.85	0.85	0.87
	36-55	0.92	0.92	0.92	0.94
Piedras	16-25	0.36	0.36	0.36	0.42
	26-35	0.83	0.83	0.83	0.84
	36-55	0.90	0.90	0.90	0.92
Juarez	16-25	0.38	0.38	0.38	0.44
	26-35	0.82	0.82	0.82	0.84
	36-55	0.90	0.90	0.90	0.92
Agua Prieta	16-25	0.38	0.38	0.38	0.46
	26-35	0.86	0.86	0.86	0.89
	36-55	0.91	0.91	0.91	0.94
Nogales	16-25	0.39	0.39	0.39	0.47
	26-35	0.86	0.86	0.86	0.86
	36-55	0.92	0.92	0.92	0.93
Matamoros	16-25	0.35	0.35	0.35	0.39
	26-35	0.81	0.81	0.81	0.81
	36-55	0.89	0.89	0.89	0.90
Nuevo Laredo	16-25	0.32	0.32	0.32	0.42
	26-35	0.80	0.80	0.80	0.83
	36-55	0.88	0.88	0.88	0.90
Reynosa	16-25	0.32	0.32	0.32	0.38
	26-35	0.80	0.80	0.80	0.79
	36-55	0.89	0.89	0.89	0.90

Source: INEGI Census. Authors Calculation.

Children % Female Population = Women 16 to 55 years of age with Children/ Female Population 16 to 55 years of age.

Table 20. Labor Supply Characteristics by Non-Border City: (%) of Female Population between the ages of 16 to 55 with Children

City	Age	Female			
		1990	1995	2000	2005
Torreon	16-25	0.31	0.31	0.31	0.35
	26-35	0.82	0.82	0.82	0.80
	36-55	0.89	0.89	0.89	0.91
Chihuahua	16-25	0.31	0.31	0.31	0.33
	26-35	0.82	0.82	0.82	0.81
	36-55	0.91	0.91	0.91	0.92
DF & Edo de Mexico	16-25	0.31	0.31	0.31	0.30
	26-35	0.79	0.79	0.79	0.73
	36-55	0.89	0.89	0.89	0.89
Guadalajara	16-25	0.24	0.24	0.24	0.26
	26-35	0.75	0.75	0.75	0.69
	36-55	0.86	0.86	0.86	0.86
Guadalupe	16-25	0.28	0.28	0.28	0.30
	26-35	0.82	0.82	0.82	0.75
	36-55	0.91	0.91	0.91	0.91
Monterrey	16-25	0.25	0.25	0.25	0.30
	26-35	0.73	0.73	0.73	0.71
	36-55	0.87	0.87	0.87	0.86

Source: INEGI Census. Authors Calculation.

Children % Female Population = Women 16 to 55 years of age with Children/ Female Population 16 to 55 years of age.

Table 21. Labor Supply Characteristics by Border City: (%) of Population between the ages of 16 to 55 that Migrated

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Mexicali	16-25	0.12	0.11	0.11	0.07	0.12	0.11	0.10	0.04
	26-35	0.10	0.09	0.08	0.06	0.09	0.08	0.07	0.05
	36-55	0.07	0.06	0.04	0.04	0.06	0.05	0.04	0.06
Tecate	16-25	0.27	0.24	0.21	0.15	0.24	0.22	0.21	0.07
	26-35	0.20	0.17	0.15	0.10	0.19	0.17	0.14	0.08
	36-55	0.15	0.13	0.11	0.08	0.13	0.12	0.11	0.07
Tijuana	16-25	0.30	0.27	0.24	0.14	0.29	0.26	0.23	0.08
	26-35	0.23	0.20	0.16	0.10	0.21	0.18	0.15	0.07
	36-55	0.15	0.13	0.10	0.06	0.14	0.12	0.10	0.06
Acuña	16-25	0.08	0.15	0.22	0.11	0.09	0.13	0.17	0.06
	26-35	0.09	0.12	0.14	0.06	0.07	0.09	0.11	0.05
	36-55	0.06	0.07	0.09	0.04	0.05	0.06	0.08	0.04
Piedras	16-25	0.06	0.07	0.07	0.03	0.06	0.06	0.07	0.04
	26-35	0.07	0.07	0.07	0.04	0.06	0.06	0.06	0.03
	36-55	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.03
Juarez	16-25	0.18	0.19	0.21	0.08	0.15	0.16	0.17	0.13
	26-35	0.12	0.12	0.12	0.05	0.10	0.10	0.10	0.11
	36-55	0.09	0.08	0.08	0.03	0.08	0.07	0.06	0.13
Agua Prieta	16-25	0.12	0.09	0.07	0.07	0.09	0.11	0.13	0.03
	26-35	0.09	0.10	0.12	0.06	0.08	0.09	0.10	0.09
	36-55	0.05	0.06	0.07	0.04	0.04	0.05	0.06	0.11
Nogales	16-25	0.21	0.19	0.17	0.11	0.17	0.16	0.16	0.14
	26-35	0.13	0.12	0.11	0.08	0.10	0.09	0.09	0.15
	36-55	0.08	0.07	0.07	0.05	0.06	0.06	0.05	0.15
Matamoros	16-25	0.11	0.12	0.13	0.06	0.12	0.13	0.13	0.14
	26-35	0.09	0.09	0.08	0.05	0.08	0.07	0.07	0.13
	36-55	0.06	0.06	0.05	0.03	0.05	0.05	0.05	0.12
Nuevo Laredo	16-25	0.10	0.13	0.16	0.11	0.11	0.13	0.16	0.11
	26-35	0.09	0.10	0.11	0.08	0.08	0.09	0.10	0.11
	36-55	0.06	0.07	0.07	0.05	0.05	0.05	0.06	0.09
Reynosa	16-25	0.11	0.17	0.23	0.18	0.12	0.17	0.22	0.07
	26-35	0.10	0.12	0.15	0.10	0.09	0.11	0.13	0.07
	36-55	0.06	0.08	0.09	0.06	0.05	0.07	0.08	0.06

Source: INEGI Census. Authors Calculation.

Migrated % Population = Men and/or Women 16 to 55 years of age Migrated from another state/Population Men and/or Women 16 to 55 years of age.

Table 22. Labor Supply Characteristics by Non-Border City: (%) of Population between the ages of 16 to 55 Migrated

City	Age	Male				Female			
		1990	1995	2000	2005	1990	1995	2000	2005
Torreon	16-25	0.07	0.06	0.05	0.04	0.07	0.06	0.05	0.03
	26-35	0.07	0.06	0.05	0.04	0.07	0.06	0.05	0.03
	36-55	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.03
Chihuahua	16-25	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02
	26-35	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.02
	36-55	0.03	0.03	0.02	0.01	0.03	0.02	0.02	0.09
DF & Edo de Mexico	16-25	0.08	0.07	0.07	0.03	0.09	0.09	0.08	0.04
	26-35	0.09	0.08	0.07	0.04	0.08	0.08	0.07	0.04
	36-55	0.06	0.05	0.05	0.03	0.05	0.04	0.04	0.02
Guadalajara	16-25	0.05	0.04	0.03	0.02	0.05	0.04	0.04	0.11
	26-35	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.12
	36-55	0.03	0.02	0.02	0.01	0.03	0.03	0.02	0.11
Guadalupe	16-25	0.04	0.04	0.04	0.03	0.04	0.04	0.05	0.08
	26-35	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.08
	36-55	0.02	0.02	0.02	0.01	0.03	0.02	0.02	0.07
Monterrey	16-25	0.07	0.08	0.08	0.07	0.08	0.08	0.08	0.06
	26-35	0.05	0.04	0.04	0.03	0.05	0.04	0.04	0.05
	36-55	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.06

Source: INEGI Census. Authors Calculation.

Migrated % Population =

Men and/or Women 16 to 55 years of age Migrated from another state/Population Men and/or Women 16 to 55 years of age.

3.4.5 The Increase in Wage Earnings and the Gender Gap

In regard to wage earnings (See Table 23), in 1997 a male maquiladora worker earned $1.04 dollars per hour while a women worker earned $.97 dollars per hour, thus for every dollar earned by a men worker a women worker only earned .93 cents. By 2005 a man worker now earned $1.97 dollars per hour while a women worker earned $1.71 dollars per hour, where a women´s workers wages now represented .87 cents of a man´s workers wages. The earning wage gap between men and women works has increased from 1997 to 2005. This trend is observed in all of maquiladora industries. Even with the overall increase in wages for both men and women workers, men´s worker wages have increased at a faster rate than those of women workers. During this period the wage differences between women workers and men workers were eliminated between 2001 and 2002. Also, during this period the maquiladora industry suffers a strong contraction caused by the US recession and by China´s entry into the WTO (Utar and Torres, 2010). Some have pointed out the maquiladora suffered a structural change during 2001, that caused the maquiladora to evolve even further from labor intensive plants to relatively more capital intensive ones (Cañas, Coronado and Gilmer, 2004). The industry downturn caused maquiladora plants to decrease in size, were the majority of the worker layoffs were women. This caused the dollar wage per hour for women workers to increase versus the male workers, since fewer women were working basically the same hours. Thus, the decrease in the earning wage gap was a direct result of the industries downturn and was eliminated when the maquiladora industry recovered its growth path.

The wage gap between industries is heterogeneous, where industries like sporting goods and toy assembly, assembly and repair tools and parts, and furniture assembly have the biggest wage gap between $.87 and $.92 cents per hour. The industries that have the lowest wage gap

are electronic and electric materials, transportation manufacturing and footwear manufacturing. All three industries have a wage gap between $.94 and $.99 cents per hour. When observing the relationship between the earnings wage gap and feminization, industries that have a wider earnings gap are not necessarily feminized or defeminized there is a mix of both, and vice versa, industries with a narrow wag gap have a mix of feminized and defeminized industries. But, there is a relationship between women losing participation in the workforce and the widening of the earnings wage gap, since both have occurred during the same period. Previous empirical research has found that feminization decreases the earnings wage gap between women and men (Carraway, 2007). The maquiladora service industry is one of the industries that pay the highest wages to workers both female and male workers. But also has the highest wage gap increase between female and male workers during the eight year span, as male workers wages have increased in a greater rate than female worker wages (See Table 23).

When observing the relationship between the labor supply characteristics for the population and the female/male earnings wage gap by city (See Table 24), education is found to have a relative stronger relationship versus the other variables like marriage and fertility. As would be the case, cities that have a higher percentage of the female population with 6 to 9 years of formal education are also the regions where the earnings wage gap is the narrowest. This can be observed in cities like Piedras and Agua Prieta. A weaker relationship is found between the cities where the ratio of female education to male education is the highest and the wage earnings gap. Education seems to play an important role in determining the wage earning gap, so as the education of female workers increases one would expect that the earnings wage gap should decrease. Fertility is also found to be related to the earnings wage gap, where cities like Nogales

Table 23 Workers Wages per Hour(US$) and The Wage Earnings Gap by Industry

Industry/Gender	Male			Female			Wage Earnings Gap		
	1997	2005	(%)	1997	2005	(%)	1997	2005	(%)
All	1.04	1.97	89.86	0.97	1.71	76.39	0.93	0.87	-7.09
Selection, preparation, packing, and	0.91	1.88	106.89	0.84	1.62	93.15	0.92	0.86	-6.64
Apparel and texitle knitting and sewing	0.86	1.51	75.68	0.80	1.39	72.49	0.94	0.92	-1.82
Footwear manufacturing and leather	0.96	2.16	123.85	0.95	2.18	128.28	0.99	1.01	1.98
Furtinure and other wood and metal	1.07	2.14	99.66	0.95	1.84	92.95	0.89	0.86	-3.36
Chemical products	1.01	1.95	93.18	0.94	1.70	81.28	0.93	0.87	-6.16
Manufacturing, re-manufacturing and	1.20	1.97	64.10	1.12	1.75	55.98	0.94	0.89	-4.95
Assembly and repair of tools, equipment	1.35	2.47	83.27	1.20	1.98	64.97	0.89	0.80	-9.98
Assembly of machinery and equipment	1.11	1.91	72.15	1.04	1.77	69.98	0.94	0.93	-1.26
Electronic and electric materials and	1.09	1.90	74.69	1.04	1.71	64.39	0.95	0.90	-5.89
Sporting goods and toy assembly	0.95	1.70	78.36	0.88	1.47	67.12	0.92	0.86	-6.31
Other manufacturing industries	1.01	1.96	94.48	0.95	1.67	74.82	0.95	0.85	-10.11
Services	1.07	2.30	115.55	0.99	1.86	88.06	0.93	0.81	-12.75

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation. Data presented is the plant average.
Hourly wages= worker wages/total hours worked. Earnings Wage Gap= Female Hourly Wages/Male Hourly Wages.

Table 24 Workers Wages per Hour(US$) and The Wage Earnings Gap by City

Industry/Gender	Male			Female			Wage Earnings Gap		
	1997	2005	(%)	1997	2005	(%)	1997	2005	(%)
All	1.04	1.97	89.86	0.97	1.71	76.39	0.93	0.87	-7.09
Mexicali	1.17	2.31	97.71	1.04	1.97	89.59	0.89	0.85	-4.10
Tecate	0.93	1.79	92.88	0.87	1.74	101.20	0.93	0.97	4.32
Tijuana	1.08	2.16	100.72	1.01	1.80	79.19	0.93	0.83	-10.73
Acuña	1.00	1.60	59.79	0.94	1.45	54.49	0.94	0.91	-3.32
Piedras	0.74	1.38	85.76	0.75	1.29	71.18	1.01	0.93	-7.85
Torreon	0.73	1.61	122.19	0.69	1.41	104.77	0.95	0.88	-7.84
Chihuahua	1.05	2.16	105.95	0.98	1.96	100.14	0.93	0.91	-2.82
Juarez	1.01	1.73	71.86	0.96	1.54	59.21	0.96	0.89	-7.36
DF & Edo de Mexico	0.87	2.05	136.15	0.80	1.66	107.02	0.92	0.81	-12.33
Guadalajara	0.94	1.87	99.49	0.84	1.61	91.83	0.89	0.86	-3.84
Guadalupe	0.90	1.87	108.12	0.70	1.67	137.07	0.78	0.89	13.91
Monterrey	0.89	1.98	122.14	0.82	1.43	74.61	0.92	0.72	-21.39
Agua Prieta	0.87	1.21	38.67	0.86	1.23	42.63	0.98	1.01	2.85
Nogales	1.04	1.97	89.56	1.02	1.65	61.01	0.98	0.83	-15.06
Matamoros	1.32	2.06	56.52	1.21	1.80	49.50	0.92	0.88	-4.48
Nuevo Laredo	1.17	2.19	88.15	1.03	1.81	75.26	0.88	0.82	-6.85
Reynosa	0.95	1.77	86.82	0.89	1.66	86.76	0.94	0.94	-0.03

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation. Data presented is the plant average.
Hourly wages= worker wages/total hours worked. Earnings Wage Gap= Female Hourly Wages/Male Hourly Wages.

and Juarez, that have a relative fertile female population are characterized for having a narrow earnings wage gap as the supply of women decreases in the workforce. In the case of marriage and migration no observable relationship is found between the two variables when relating the variables with the earnings wage gap.

3.5 Empirical Model and Results

An OLS model is estimated to investigate the participation of women workers and the female/male earning wage gap in the maquiladora plant.

3.5.1 Employment Gender Model and Results

The proposed model to estimate the female workers ratio by a maquiladora establishment is as follows:

$$Fratio_{ijmst} = \alpha_0 + \alpha_1\ Age_{ijmst} + \alpha_2\ lSize_{ijmst} + \alpha_3\ Skill\text{-}intensity_{ijmst}$$
$$+ \alpha_4\ Capital\text{-}intensity_{ijmst} + \alpha_5\ Multi\text{-}plant_i + \alpha_6\ Border_m$$
$$+ \sum_i Industry + \sum_{st} State * Year + \in_{ijmst}$$

where $Fratio_{ijmst}$ refers to the ratio of female workers to total workers. Subscripts i, j, m, s, and t index plant, industry, city, state and year respectively. Fixed effects are included for state-by-year to control for aggregate shocks that may affect employment across all sectors buy may vary across different states and time for example due to local labor market conditions. Additionally, industry specific fixed effects such as differences in technology are controlled for that may affect women's employment. The base models explanatory variables are time varying plant-level controls that are found to be important in determining women's participation in the plant workforce like: age, size, labor skill, capital intensity and if the plant is a multi-plant. Plant age is estimated as the difference from the current year and the year it started operations. Thus, plants that appear in their first year have an age of zero. Size is measured as logged total employment

by plant j. To measure skill intensity the ratio of technicians to total employees by plant j industry i and year t are estimated. Since technicians are skilled workers that are involved directly with the production process, i.e. oversee operations, quality control, and work assignments of the factory workers in the maquiladora plant. There is no information on capital equipment at the plant level for the maquiladora industry. Thus, a series of capital proxy variables were estimated. To do so, the renting of machinery, equipment and transport in the country and the renting of real estate in real terms were added to measure domestic capital expenditures. The estimated variable served as an approximation to the amount of capital at each plant, given the relationship between capital to its expenditures. To test this relationship, a correlation coefficient was estimated between rental capital expenditure at the state-level and maquiladora FDI capital purchases at the state level[24]. The correlation coefficient between the two variables was found to be 0.923 for the period from 1994-2006. Then domestic capital expenditures were divided by real value added or by total hours worked by all maquiladora employees. A regional border city dummy variable is included to distinguish the effects of being located along the US-Mexico border.

The evolution of the maquiladora plant from labor intensive to capital intensive should be reflected in the age of the plant. This would cause the participation of women to drop as the maquiladora plants gets older, causing α_1 to have a negative sign. Larger plants are characterized for being more labor intensive plants that require less skill in the workforce, thus α_2 should have a positive sign. If there is an increase in labor skill and capital intensity by the maquiladora plant then the participation of women workers should decrease then α_3 and α_4 should have a negative sign. This result is based on previous research findings for export oriented industries,

[24] Source: Secretaria de Economía. State-level maquiladora FDI is the only disaggregated capital data available.

were as the export manufacturing plant evolves from low skill intensity(low capital-intensive) to high skill intensity(high capital intensive) female participation decreases. Multi-plants are characterized for being older, bigger, more productive, with a greater access to technology and capital, etc. (Bernard & Jensen, 2002). This would cause α_5 to have a negative sign, if the plant is part of a series a plants owned by the same firm. The first maquiladora plants were established along the border cities, they have evolved from low skill labor to high skill labor having a negative effect on the employment of women thus α_6 should have a negative sign.

An additional group of explanatory variables are incorporated. These second groups of explanatory variables are time varying labor supply controls that effect the supply of labor in those municipalities: years of schooling, marital status, fertility and migration.

$$\begin{aligned} Fratio_{ijmst} = \; & \alpha_0 + \alpha_1 \, Age_{ijmst} + \alpha_2 \, lSize_{ijmst} + \alpha_3 \, Skill\text{-}intensity_{ijmst} \\ & + \alpha_4 \, Capital\text{-}intensity_{ijmst} + \alpha_5 \, Multi\text{-}plant_i + \alpha_6 \, Border_m \\ & + \alpha_6 \, Education_{mst} + \alpha_7 \, Marital\ Status_{mst} + \alpha_8 \, Offspring_{mst} \\ & + \alpha_9 \, Migration_{mst} + \sum_s State + \sum_{st} Year \\ & + \sum_i Industry + \in_{ijmst} \end{aligned}$$

Fixed effects are included for state and year to control for aggregate shocks that may affect wages across all sectors buy may vary across different states and time. Also, industry fixed effects are included. The labor supply control variables are estimated as percentages from the total population by gender. These variables are the ratio of the percentages of female to the male population between the ages of 16 to 55 years with the exception of the fertility variable that is not a ratio. The years of schooling variable refers to the ratio of the female population to the male population with 6 to 9 years of schooling. The marital status variable is the ratio of the

female population to the male population that is married. The fertility variable denotes the percentage of the female population that has at least one child. The migration variable indicates the ratio of the female population to the male population that has migrated to the city.

When the labor supply control variables are added to the base model if the percentage of the female population with years of schooling increases over the male percentage then a greater number of women should be hired - given that women´s education levels are increasing relative to that of man -, so the expected sign for α_6 should be positive. Marital and motherhood duties have a negative effect on the participation of women in the maquiladora plant causing α_7 and α_8 to both have a negative sign. The effect of migration of women relative to that of men from other regions should increase the participation of women of the workforce, since women are moving looking for job market opportunities in the region, thus α_9 should have a positive sign.

A possible issue with the model presented is that the estimation coefficients could be incorrect since the dependent variable is a fractional variable. Given that the dependent variable is bounded between 0 and 1 and the estimated values from an OLS regression can lie outside the range of 0 to 1 (Papke & Wooldridge, 2006). Sharing the same shortcomings with the linear probability model for binary data. To try to solve this issue, two alternative estimation procedures are recommended. The first one and the most common one as mentioned by Papke & Wooldridge (2006) is to transform the dependent variable into a log-odds ratio:

$$\log [Fratio_{ijmst} / (1 - Fratio_{ijmst})]$$

The transformation into the log-odds ratio of the dependent variable is simple and the model can continue to be estimated using OLS. Nonetheless, there are issues related with the linear model of the log-odds ratio. The estimation of this linear model will only work if the dependent variable

lies strictly between 0 and 1 (Papke & Wooldridge, 2006). Additionally, it is difficult to recover the expected value of the dependent variable (Papke & Wooldridge, 2006). The second alternative procedure supported by Papke & Wooldridge (2006) is to use Quasi-Likelihood Methods, were a Generalized Linear Model should produce consistent estimators overcoming previous model deficiencies. Both alternative procedures are estimated to verify the robustness of the estimation results.

Another possible issue could be endogeneity, as the plant maquiladora variables and the labor supply variables could be possible related to unobserved factors resulting in an omitted variable problem. For example, the industries mix in the city that could affect the plant characteristics as well as local labor supply characteristics. This would cause the coefficient estimates to be biased. Endogeneity could also arise because of simultaneity issues since the participation of women could be determined simultaneously with the plant characteristics as well as the supply characteristics. The endogeneity of the independent variables would result in the inconsistency of OLS, as the changes in the independent variables would not only be associated with changes in the female participation rate, but also with changes in the error term. Given the possible inconsistency of the OLS estimates the results will be considered to show more of an association between the variables in the model then causation.

In Table 25 the results for the female participation model are presented. In column 1, a relationship is found for size, that possible indicates that the participation of women workers increases in bigger plants. On the other hand, skill-intensity and capital-intensity were found to have a negative relationship on the participation of women workers, which

Table 25 The Determinants of Women´s Participation in the Maquiladora Industry from 1990-2006

Dependent Variable *Fratio*	(1)	(2)	(3)
age	-0.0005	0.0007	-0.0021
	(0.00111)	(0.00592)	(0.00495)
lsize	0.0342	0.0908	0.1519
	(0.00259)***	(0.01381)***	(0.01175)***
skill-intensity	-0.1142	-0.4783	-0.5105
	(0.03820)***	(0.21304)**	(0.17434)**
capital-intensity	-0.1317	-0.4892	-0.6563
	(0.06943)*	(0.31284)	(0.42217)
multiplant	0.0047	0.0714	0.024
	(0.01276)	(0.06864)	(0.05757)
border	-0.0750	-0.4975	-0.3300
	(0.02113)***	(0.11532)***	(0.09325)***
State-Time Level Controls	Yes	Yes	Yes
Industry-Level Controls	Yes	Yes	Yes
Number of Observations	29,055	25,458	29,055
R^2	0.2954	0.2226	

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Standard errors are reported in parentheses.Dependent variable is the ratio of female to total workers.

Estimates standard errors are clustered for each plant.

*, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

(1) Estimated results for the OLS Model. (2) Estimated results for the Log-Odds Linear Model.

(3) Estimated results for the General Linearized Model (Quasi-Likelihood Method)

shows an association between an increase in plant skill-intensity and capital-intensity and a reduction in the number of women workers. Also, being located along the U.S- Mexican border was found to be related to a negative effect to the employment of women workers. Border plants are characterized for being more skill and capital intensive, as well as being older plants. In column (2) and column (3) the estimated results are presented for the log-odd ratio linear model and the Generalized Linear Model, respectively. The estimation results for both models are found to be consistent with those of the OLS model. As size, skill-intensity and border location are found to be associated to the participation of women. In summary, plant characteristics and border location are found to be related to the participation of women, after controlling for state-by-year and industry fixed effects.

In Table 26 the results are presented for the female participation model with the addition of labor supply variables. In column 1, the base female participation model is re-estimated for the corresponding five years intervals from 1990 to 2005 and again size is found to be related to capital-intensity and border location. Fixed effects for state-by-year and industry are included. In column 2, the female participation model is estimated with the labor supply controls, and again size, capital-intensity and border location are found to be associated with female participation. No association was found with the labor supply control variables. The model included state and industry fixed effects. In column 3, only year and industry fixed effects are included, and again size, capital-intensity and border location are found to be related to female participation. Interestingly, again none of the labor supply characteristics were found to be related. All six columns were re-estimated utilizing labor supply characteristics with the age group between 16 to 25 years. The same results were achieved in a consistent manner. In addition, the log-odd ratio linear model

Table 26 The Determinants of Women´s Participation in the Maquiladora Industry

Dependent Variable *Fratio*	(1)	(2)	(3)
age	-0.0006	-0.0005	-0.0001
	(0.00112)	(0.00112)	(0.00109)
lsize	0.0310	0.0310	0.0303
	(0.00279)***	(0.00279)***	(0.00274)***
skill-intensity	-0.0545	-0.0499	-0.0665
	(0.041724)	(0.04164)	(0.04142)
capital-intensity	-0.5234	-0.5188	-0.5046
	(0.21148)**	(0.21085)**	(0.20836)**
multiplant	0.0059	0.0056	-0.007
	(0.01298)	(0.01260)	(0.01084)
border	-0.0768	-0.075	-0.050
	(0.02169)***	(0.02169)***	(0.01497)***
education		1.5244	1.3554
		(1.52439)	(1.07487)
married		0.5933	0.6238
		(1.08456)	(1.097281)
fertility		-0.1772	-0.1140
		(1.14831)	(1.16418)
migrant		-0.2175	-0.2510
		(0.51907)	(0.52579)
Year-Level Controls	No	Yes	Yes
State-Level Controls	No	Yes	No
State-Time Level Controls	Yes	No	No
Industry-Level Controls	Yes	Yes	Yes
Plant Fixed Effects	No	No	No
Number of Observations	6,646	6,646	6,646
R^2	0.2963	0.2930	0.2457

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation.

Standard errors are reported in parentheses. Dependent variable is the ratio of female to total workers.

OLS estimates standard errors are clustered for each plant.

For the years 1990-1995-2000-2005. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

and the Generalized Linear Model where estimated with the labor supply variables. Once again the estimation results were found to be consistent with those of the OLS model.

The estimates are consistent in finding an association between women´s participation in the maquiladora industry and plant characteristics such as: age, size and capital-intensity. Plant characteristics seem to play a role in the participation of women in the maquiladora workforce. In contrast, no relationship was found between participation of women in the maquiladora workforce and labor supply characteristics.

3.5.2 Earnings Wage Gap Model

What happens to the differences in wages between women and men in the maquiladora plant when women increase their participation? In order to analyze the impact of feminization on the earnings wage gap between women and men the following equation is estimated:

$$\begin{aligned} HRearnings_{ijmst} = \; & \alpha_0 + \alpha_1 \, Fratiofm_{ijmst} + \alpha_2 \, Age_{ijmst} + \alpha_3 \, lSize_{ijmst} \\ & + \alpha_4 \, Skill\text{-}intensity_{ijmst} + \alpha_5 \, Capital\text{-}intensity_{ijmst} + \alpha_6 \, Multi\text{-}plant_i \\ & + \alpha_7 \, Border_s + \sum_i Industry + \sum_{st} State * Year \\ & + \in_{ijmst} \end{aligned}$$

where $HRearnings_{ijmst}$ refers to hourly male and female earnings per hour by employee category. Subscripts i, j, m, s, and t index plant, industry, municipality, state and year respectively. The ratio of women to men by category of employee is included to measure the effects of the participation of women on gender wage earnings. The categories of employees are: workers, technicians, and administrative. The base group of independent variables includes time varying plant-level controls that are found to be important in determining the earnings wage gap

between women and men like plant age, size, labor skill, capital intensity, multi-plant and the border location. Again, fixed effects are included for state-by- year and industry specific fixed effects.

If the participation of women relative to men increases and the sign for α_1 is negative then women on average are receiving lower pay than men for all the different employee categories. The evolution of a plant from less skill intensive to more skill intensive should be reflected in the age of the plant, affecting positively the wage earnings paid to the workforce causing α_2 to have a positive sign. The size of the plant should have a negative effect on wage earnings, since larger plants are less skill intensive causing the salaries of workers to be lower versus smaller plants that are more skill intensive, thus α_3 should have a negative sign. The skill intensity and capital intensity variables should have positive coefficients since greater labor skill and capital use translates into a higher wage, making the signs for α_4 and α_5 positive. If the plant is part of a firm with numerous plants the access to technology and capital would be less difficult, making them more capital-intensive vs. single-plant firms, causing α_6 to have a positive sign. Maquiladora wages in border regions are higher than in non-border regions. One reason for this is that the cost of living in border regions is higher than in non-border regions causing larger salaries to be paid along the border versus interior regions. Another reason is that the first maquiladoras where established on the border between Mexico and the United States, and on average plant age is higher in these regions. This would cause α_7 to have a negative sign, since border maquiladora plants have been a part of the movement from low skill to higher skill manufacturing processes.

Once more, an additional set of explanatory variables are included. The second group includes time varying labor supply controls that affect the differences between the supply of labor in those cities between women and men like the years of schooling, marital status, fertility and migration.

$$HRearnings_{ijmst} = \alpha_0 + \alpha_1\ Fratiofm_{ijmst} + \alpha_2\ Age_{ijmst} + \alpha_3\ lSize_{ijmst} + \alpha_4\ Skill\text{-}intensity_{ijmst} + \alpha_5\ Capital\text{-}intensity_{ijmst} + \alpha_6\ Multi\text{-}plant_i + \alpha_7\ Border_s + \alpha_8\ Education_{mst} + \alpha_9\ Marital\ Status_{mst} + \alpha_{10}\ Offspring_{mst} + \alpha_{11}\ Migration_{mst} + \sum_s State + \sum_{st} Year + \sum_i Industry + \in_{ijmst}$$

Fixed effects are included for state and year to control for aggregate shocks that may affect wages across all sectors buy may vary across different states and time. Also, industry fixed effects are included. The education levels of the population should have a positive effect on the wage earnings gap as a greater percentage of the population have more years of schooling. This relationship would cause α_8 to be positive. Marital status and fertility would cause a negative on wage earnings since marital and motherhood duties could have a negative effect on the contribution at the workplace, thus the coefficients for both α_9 and α_{10} should both be negative. Previous empirical research have found that migration has caused wages to decrease as the supply of labor increases and should decrease wages if labor demand doesn't increase, so migration from other regions should have a negative effect on the wage earnings making the coefficient α_{11} negative.

Table 27 The Determinants of Hourly Earnings in the Maquiladora Industry by Employee Category from 1997-2006

Dependent Variable Real Hourly Earnings by Employee	(1)	(2)	(3)	(4)
female participation	-0.0002	-0.0455	-0.2067	-0.0336
	(0.00005)***	(0.03448)	(0.05444)***	(0.02918)
age	0.0019	0.0015	-0.0151	0.0019
	(0.00077)**	(0.00335)	(0.00599)**	(0.00198)
lsize	0.0010	0.0100	0.0886	0.0011
	(0.00179)	(0.00902)	(0.01417)***	(0.00499)
skill-intensity	0.0300	-0.5514	0.2743	0.3743
	(0.016523)*	(0.07597)***	(0.08900)**	(0.05333)***
capital-intensity	2.5255	11.1910	12.6693	4.6857
	(0.34910)***	(3.39215)***	(3.76393)***	(0.99063)***
multiplant	-0.0027	-0.0335	0.0355	0.0108
	(0.00720)	(0.02894)	(0.05467)	(0.01697)
border	-0.0265	-0.0702	-0.0747	-0.0721
	(0.01138)**	(0.05084)	(0.09349)	(0.02991)**
State*Year -Level Controls	Yes	Yes	Yes	Yes
Industry-Level Controls	Yes	Yes	Yes	Yes
Number of Observations	18,735	16,760	18,573	19,452
R^2	0.1801	0.2271	0.1482	0.1711

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation. Robust standard errors are reported in parentheses.
Female participation = # of female/ # male , lsize= log employment, skill-intensity= total technitians / total production workers,
capital-intensity= domestic capital expenditures/total hours worked. Dependent variable is real hourly earnings in pesos.
Column (1) workers, Column (2) technicians, Column (3) administrative and Column (4) all employees.
OLS estimates standard errors are clustered for each plant in year. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

For the second equation issues of endogeneity are also present, as unobserved factors could have an effect on the ratio female/male participation in the workforce as well as the other variables. Simultaneity issues could also be present, were at least one of the plant and labor supply characteristics can be simultaneously determined with the hourly female and male earnings.

In Table 27, the results for the hourly earnings by employee category are presented. In column 1, a negative relationship is found for the ratio of female workers to male workers. The negative sign is indicating that women workers are receiving a lower wage than men workers. The border dummy is also found to negatively associated, indicating that border location has a negative relationship on real hourly earnings. A positive relationship is found for age, skill-intensity and capital-intensity, indicating that older plants and capital-intensive plants pay higher wages. In column 2, the ratio of female technicians to male technicians is found to have a weaker negative relationship, while skill-intensity is found to have both a stronger negative association with real hourly earnings. The negative relationship of skill-intensity on real technician's earnings is related to the fact that this variable is estimated as the ratio of technicians to total employees so as the ratio increases this would cause a decrease in hourly real earnings as the number of technicians has increased. The model was re-estimated eliminating skill-intensity, and again a negative relationship was found with the ratio of female participation over male participation. In addition, capital-intensity is found to have positive relationship on hourly earnings. In column 3, the ratio of female administrative employees to male administrative

Table 28 The Determinants of Hourly Earnings in the Maquiladora by Industry Category from 1997-2006

Dependent Variable Real Earnings	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
female participation	-0.0047	0.0001	0.0001	-0.0001	-0.0025	-0.0001	-0.0032	-0.0006	-0.0003	-0.0011	-0.0015	-0.0017
	(0.00880)	(0.00019)	(0.00022)	(0.00004)**	(0.00106)**	(0.00005)**	(0.00081)***	(0.00023)**	(0.00014)**	(0.00125)	(0.00042)***	(0.00086)**
age	-0.0183	0.0015	0.0058	0.0002	0.0024	0.0007	0.0038	0.0011	0.0053	-0.0202	0.0026	0.0044
	(0.01481)	(0.00198)	(0.00399)	(0.00114)	(0.00356)	(0.00192)	(0.00276)	(0.00124)	(0.00194)**	(0.02351)	(0.00182)	(0.00253)*
lsize	0.0010	0.0103	0.0012	0.0046	-0.0040	0.0038	0.0034	0.0140	-0.0069	-0.0042	-0.0025	0.0047
	(0.01253)	(0.00432)**	(0.01109)	(0.00331)	(0.00696)	(0.00405)	(0.00753)	(0.00383)***	(0.00613)	(0.00873)	(0.00400)	(0.00608)
skill-intensity	0.0937	-0.0564	0.2677	0.0293	-0.0349	0.0612	0.0930	0.0435	0.0464	0.0155	-0.0087	0.0828
	(0.15887)	(0.05291)	(0.13531)**	(0.03758)	(0.05980)	(0.05124)	(0.05450)*	(0.06041)	(0.03923)	(0.18486)	(0.03593)	(0.05287)
capital-intensity	-1.3608	11.1475	1.3221	0.6118	1.2501	3.3632	1.6288	6.3834	3.6722	0.4385	2.5767	1.8662
	(1.2115)	(5.16068)**	(0.44745)***	(0.69027)	(0.89575)	(1.05565)***	(1.17736)	(1.46813)***	(1.10346)***	(0.20333)**	(0.39185)***	(0.29005)***
multiplant	0.0983	-0.0024	0.0157	-0.0060	-0.0188	0.0386	0.0068	0.0425	-0.0149	0.1460	-0.0131	-0.0133
	(0.05559)*	(0.01894)	(0.03596)	(0.01292)	(0.01864)	(0.01881)**	(0.03033)	(0.01742)**	(0.02371)	(0.18992)	(0.01524)	(0.02872)
border	0.2005	-0.0347	-0.1487	-0.0344	0.0081	0.0072	-0.0463	-0.1051	-0.0363	0.2085	-0.0573	-0.0102
	(0.14893)	(0.02720)	(0.04055)***	(0.03215)	(0.01792)	(0.02590)	(0.03040)	(0.03309)***	(0.03132)	(0.28648)	(0.04150)	(0.03414)
State*Year -Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	282	2,253	213	2,599	1,143	1,739	451	1,161	3,849	267	3,403	1,375
R^2	0.4390	0.1250	0.1291	0.0956	0.1001	0.6316	0.2743	0.7246	0.2209	0.3910	0.1775	0.3984

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation. Robust standard errors are reported in parentheses.

Female participation = # of female/ # male , lsize= log employment, skill-intensity= total technitians / total production workers,

capital-intensity= domestic capital expenditures/total hours worked. Dependent variable is real hourly earnings in pesos .

Column (1) workers, Column (2) technicians, Column (3) administrative and Column (4) all employees.

OLS estimates standard errors are clustered for each plant in year. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

employees is found to be associated negatively, as well as the age variable. Both the skill-intensity and capital-intensity variables are found to be positively related to hourly earnings. In column 4, the ratio of all female employees over all male employees is found to be negative related as well as the border variable. Also, both the skill-intensity and capital-intensity variables are found to be positively associated. This model was re-estimated eliminating the skill-intensity variable since the variable is estimated as the ratio between technicians and all employees and possible could affect the results of the wage disparity measure. When, the variable was dropped the gender participation ratio was found to be associated positively. In all four models, state-by-year and industry fixed effects are included to control for possible shocks that could differ across states and industries. In all the different types of employee categories a relationship was found that women on average are receiving lower pay than men. This same exercise was done by industry classification. The results are presented in Table 28. In eight of the twelve industries the ratio of female workers over male workers a negative relationship was found. The capital-intensity measure was found to be associated positively in eight of the twelve industries.

In Table 29, the results are presented for the hourly earnings model with labor supply control variables. In column 1, the base hourly earnings model is re-estimated for the corresponding five years intervals from 1990 to 2005. A negative relationship is found for the ratio of female workers to male workers and for the border dummy, while a positive association is found for skill- intensity and capital-intensity after controlling for industry and state by year fixed effects. The negative sign of the female to male ratio indicates a disadvantage with being a female worker, that women workers are receiving a lower wage than the male workers. The border dummy variable registers an unexpected negative sign. In column 2, the labor supply

Table 29 The Determinants of Hourly Earnings in the Maquiladora Industry

Dependent Workers Real Hourly Earnings	(1)	(2)	(3)
femw	-0.0001	-0.0001	-0.0001
	(0.00005)**	(0.00005)**	(0.00004)**
age	0.0009	0.0009	0.0010
	(0.00032)**	(0.00032)**	(0.00031)***
lsize	0.0037	0.0036	0.0032
	(0.00088)***	(0.00089)***	(0.00085)***
skill-intensity	0.0391	0.0395	0.0375
	(0.01436)**	(0.01451)**	(0.01449)**
capital-intensity	0.7183	0.7087	0.7062
	(0.20044)***	(0.20252)***	(0.20196)***
multiplant	-0.0014	-0.0027	-0.0079097
	(0.00357)	(0.00359)	(0.00308)**
border	-0.0185	-0.0184	-0.0051348
	(0.00558)***	(0.00554)***	(0.00431)
education		-0.4248	-0.5268
		(0.34635)	(0.34444)
marriage		0.0811	0.0890
		(0.31674)	(0.31955)
fertility		-0.2969	-0.2666
		(0.48930)	(0.49304)
migrant		-0.2116	-0.2222
		(0.15077)	(0.14835)
Year-Level Controls	No	Yes	Yes
State-Level Controls	No	Yes	No
State*Year -Level Controls	Yes	No	No
Industry-Level Controls	Yes	Yes	Yes
Plant Fixed Effects	No	No	No
Number of Observations	3,874	3,874	3,874
R^2	0.1696	0.1541	0.1430

Source: Plant-level Survey of Maquiladoras (INEGI). Authors Calculation. Robust standard errors are reported in parentheses. femw= # of female worker/ # male worker, lsize= log employment, skill-intensity= total technitians / total production workers, capital-intensity= domestic capital expenditures/total hours worked. Dependent variable is real hourly earnings in pesos. For the years 1990-1995-2000-2005.OLS estimates standard errors are clustered for each plant in year.
*, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

control variables are included, again the ratio of female workers to male workers, skill-intensity, capital-intensity and the border dummy are found to be associated with hourly earnings. Were, no labor supply variable is found to be associated to hourly earnings. Fixed effects are included to control for year, state and industry. In column 3, time and industry fixed effects are included and once again the ratio of female to male workers, skill-intensity and capital-intensity are found to be related with hourly earnings. In addition, the multi-plant variable is found to be related negatively. Yet again, no labor supply control variable was found to be associated with hourly earnings. Once more, all three columns where re-estimated utilizing labor supply characteristics with the age group between 16 to 25 years. The same results were achieved in a consistent manner.

The estimates are consistent in finding a relationship between female participation and lower wage earnings. Plant characteristics are also found to be associated to hourly earnings. In a consistent manner skill-intensity and capital-intensity presented a positive relationship with hourly earnings, the border dummy demonstrated a negative relationship with hourly earnings.

3.6 Concluding Remarks

The purpose of this study was to investigate the trend toward and away from feminization in an export oriented industry. To address this questions plant level data was used for the maquiladora industry. The use of plant level allowed for a better control of heterogeneous characteristics for each plant that are related with female worker employment. Also labor supply characteristics were included to control for the participation of women in the labor force of each region. The descriptive analysis of the information shows that overall the participation of women workers in all 12 industries has dropped, while during the same period, plant skill intensity has increased, as the share of technicians to total employees has increased.

Evidence is provided that the participation of women is associated to plant characteristics – size, skill-intensity and capital intensity-, were no relationship was discovered between labor supply characteristics and female participation. The plant level information. In addition, association was found that shows that women workers are receiving a lower wage versus the male workers. Were the descriptive analysis of the information also shows that the earning wage gap between men and women works has increased from 1997 to 2005. This trend is observed in all 12 of the maquiladora industries. Even with the overall increase in wages for both men and women workers, men´s worker wages have increased at a faster rate than those of women workers The results indicate an association between plant characteristics and hourly earnings in the maquiladora plants. In contrast, labor supply characteristics were not found to be related to hourly earnings in the maquiladora industry.

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APPENDIX

A. METHODOLOGY OF ESTIMATED VARIABLES

Sales = [Export Value Added + Foreign Inputs Consumed]

Real Export Value Added= [Export Value Added/ PPI by industry *i*]

Non-Production Workers= Administrative Employees

Production Workers= Workers + Technicians

Real Inputs Consumed = [Inputs Consumed / PPI by industry *i*]

Energy Consumed =

[Electricity consumption/ PPI electricity]+[Fuel consumption/PPI fuel]

Real renting of machinery, equipment and transport =

Renting of machinery, equipment and transport / PPI renting of machinery and equipment

Real renting of real estate =

renting of real estate / PPI renting of building non-residential

Capital proxy (domestic capital expenditures) =

[Real renting of machinery, equipment and transport + Real renting of real estate]

Capital intensity =

Capital proxy / Sales or Profit / Total Hours Worked(or Total Employment) or

Capital proxy / Total Hours Worked(or Total Employment)

Hourly salaries paid to workers =

[(Salaries Paid to Workers(production) x 1000)/ Worker(production)- Hours Worked]

Relative salaries paid to workers=

Hourly salaries paid to workers Maquila / Hourly salaries paid to workers U.S.

Actual applied tariff= Calculated Duties / Custom Value

and/or

Dutiable Value / Custom Value (without duty free imports)

Industry import penetration in industry i in year t,

$INDIMP_{it} =$ ————

where,, is the value of imports from all countries, is the domestic production and are exports.

Import penetration of country y in industry i in year t,

$IMP_{yit} =$ ————

where, is the value of imports from country y, is the value of imports from all countries, is the domestic production and are exports.

Country y imports of total imports in industry i in year t,

$CIMP_{yit} =$ ——

where, is the value of imports from the country y, and is the value of imports from all countries.

Industry import penetration in industry i in year t without country´s y imports,

I$NDIMPW_{it} =$ ————

where, is the value of imports from country y, is the value of imports from all countries, is the domestic production and are exports.

Calculation of Plant TFPs

We use KLEM approach and calculate multi-factor productivity using gross-output measures. Good, Nadiri and Sickles (1997) discusses the extension of the total factor productivity index that incorporates both the chaining approach and the hypothetical firm approach of Caves, Christensen and Diewert (1982) that is suitable for panel data-setting. We construct a hypothetical firm whose subcomponent expenditure shares are the arithmetic mean expenditure shares and whose subcomponent quantities are the geometric means of the subcomponent quantities for each cross section. We then chain the hypothetical firms together over time.

$$lnTFP_{jt} = (q_{jt} - \overline{q_t}) + \sum_{s=2}^{t} (\overline{q_s} - \overline{q}_{s-1}) - [\sum_{i=k,l,e,m} 0.5 * (\alpha^i_{jt} + \overline{\alpha^i_t})(x^i_{jt} - \overline{x^i_{jt}}) + \sum_{s=2}^{t} \sum_{i=k,l,e,m} 0.5 * (\overline{\alpha^i_s} + \overline{\alpha^i_{s-1}})(\overline{x^i_s} - \overline{x^i_{s-1}})]$$

where *qit* is the logarithm of deflated sales of plant j, and $x^i jt$ is the logarithm of the input i used by plant j at period t where type of input is indicated with superscript *i = k, l, e,m*. l denotes labor measured by the total number of hours worked, k denotes capital measured by the deflated rental expenditures on buildings, machinery and equipment, e denotes energy measured by deflated expenditures on fuel and electricity and m denotes materials measured by deflated expenditures on domestic and imported materials. The bar indicates an average over the relevant variable (e.g. $\overline{\ }_t$ indicates the natural logarithm of the geometric average for output across all plants at period t). Scale elasticity's are calculated using costs shares.

Exchange Rates

We use industry-specific exchange rate measures for the US manufacturing industries constructed by Linda Goldberg. The data can be downloaded from http://www.newyorkfed.org/research/global_economy/industry_specific_exrates.html.

These measures are constructed by using the time histories of the weights of U.S. trading partners in the exports and imports of each U.S. industry. Each industry is denoted by an index i and each country/trade partner of that industry by an index c. The industry-specific real exchange rate indexes depart from the aggregate indexes in that the weights of each partner currency (country c) are the shares of that partner c in the U.S. exports or imports of that specific industry i.