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# **The Impact of the Crisis of 2008 on Women's and Men's Income in Mexico**

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on Women's and Men's Income in Mexico

Julia-Maria Becker

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# Contents

<b>1</b>	<b>Resumen</b>	<b>4</b>
<b>2</b>	<b>Introduction</b>	<b>6</b>
<b>3</b>	<b>The Crisis of 2008 and its Effect on the Mexican Economy</b>	<b>7</b>
<b>4</b>	<b>Theoretical Model for the Impact of a Crisis on the Labor Market</b>	<b>9</b>
4.1	Evidence for the Impact of Crises on Labor Markets . . . . .	10
4.2	Differentiation of the Impact of Crises between Women and Men . . . . .	12
<b>5</b>	<b>Data</b>	<b>15</b>
<b>6</b>	<b>Empirical Methodology</b>	<b>16</b>
6.1	Regression Model for the Impact of the Crisis on Income and Worked Hours	20
6.1.1	Results for the Impact of the Crisis on Labor Income and Worked Hours	22
6.2	Regression Model for the Impact of the Crisis with Sector Distinction . . . . .	24
6.2.1	Results for the Impact of the Crisis on Labor Income and Worked Hours with Sector Distinction . . . . .	25
6.3	Regression Model for the Distinction of the Impact of the Crisis between Mex- ican Women and Men . . . . .	28
6.3.1	Results for the Distinction of the Impact of the Crisis between Women and Men . . . . .	29
6.4	Differentiating the Impact of the Crisis for Women and Men in the Manufac- turing and Commerce Sector . . . . .	30
6.4.1	Results for the Impact of the Crisis for Women and Men in the Man- ufacturing and Commerce Sector . . . . .	31
6.5	Regression for the Impact of the Crisis on Labor Income and Worked Hours of Single Mothers . . . . .	32

6.5.1	Results for the Regressions for the Impact of the Crisis on Labor Income and Worked Hours of Single Mothers . . . . .	33
<b>7</b>	<b>Conclusion</b>	<b>34</b>

# 1 Resumen

En un mundo que cada día está más conectado y en donde los países interactúan en los mercados mundiales con una frecuencia como nunca antes, una crisis económica tiene un alcance mucho más amplio que hace algunos años. Por lo tanto, el interés común en los posibles impactos de una crisis está creciendo. Kaplan et al. (2011) muestran que la crisis de 2008 tuvo un impacto negativo en el empleo y los salarios en México, pero sólo consideran el empleo formal. Menos se sabe sobre el impacto de la crisis en el ingreso laboral y las horas trabajadas de la población económicamente activa, en el ingreso de personas trabajando en diferentes sectores y el impacto en grupos que por lo general se consideran altamente vulnerables, como las mujeres o las madres solteras. En el siguiente análisis se usa el método de diferencias en diferencias para medir el impacto de la crisis en el ingreso laboral y las horas trabajadas de mujeres y hombres en México, tomando en cuenta los diferentes sectores.

La presente investigación tiene tres cadenas principales: 1. Se provee evidencia de que la crisis de 2008 tuvo un impacto en los ingresos laborales y las horas trabajadas; 2. Se muestra que las diferentes regiones y sectores en México se vieron afectados de manera diferente; 3. Se distingue el impacto de la crisis entre mujeres y hombres, y se enfoca en las madres solteras.

Los resultados de la presente investigación muestran que la crisis de 2008 tuvo un considerable impacto negativo en los ingresos laborales de la población mexicana que vive en las regiones integradas al comercio internacional. Las personas que viven en los estados del norte del país experimentaron el mayor impacto negativo en su ingreso laboral y sus horas trabajadas. Analizando el impacto en la población ocupada, en lugar de toda la población económicamente activa, aún se encontró un impacto negativo en el ingreso laboral por lo que se puede concluir que durante la crisis los ingresos laborales no sólo fueron reducidos por los despidos, sino también por una reducción de los ingresos de la población ocupada. Enfocándose en el sector manufacturero y en el sector comercial, siendo estos los dos sectores que experimentaron las tasas de despido más altas durante el período de la crisis, al contrario a las expectativas comunes, los individuos en el sector manufacturero sufrieron de la misma forma como individuos de otros sectores de una reducción de los ingresos y empleados en el sector

comercial incluso sufrieron menos que personas de otros sectores. Las mujeres mexicanas en el sector manufacturero, sin embargo, sufrieron una reducción mayor de sus ingresos laborales que mujeres en otros sectores, pero en general, las mujeres mexicanas no experimentaron una reducción de los ingresos laborales más alta que los hombres, si no la diferencia entre los ingresos laborales de hombres y mujeres se redujo significativamente durante la crisis.

## 2 Introduction

In a world that gets more and more connected every day, and where countries interact on global markets with a frequency like never before, an economic crisis has an effect with a reach much wider than some years ago. Thus, the growing exposure of countries to short-term exogenous shocks shifts the common interest on the impacts of these shocks. Kaplan et al. (2011) show for the Mexican case that the crisis of 2008 had a negative impact on employment and wages but only for the formally employed. Less is known about the impact of the crisis of 2008 on labor income and worked hours for the whole economically active population, individuals working in different sectors, and commonly considered highly vulnerable groups like women or single mothers. I use a difference-in-differences estimator to measure the impact of the crisis on the labor income and worked hours of Mexican women and men working in different sectors.

The following investigation has three main strings: 1. I will provide evidence that the crisis of 2008 had an impact on labor income and worked hours; 2. I will show that different regions and sectors in Mexico were affected differently; 3. I distinguish the impact between women and men, and focus on single mothers.

In section three I provide a description of how the crisis of 2008 affected the Mexican economy and the Mexican Labor Market in particular. I then describe the theoretical model of the behavior of labor markets faced with exogenous shocks, followed by a description of the evidence of a differentiated impact of the crisis among genders. I continue by describing the data set in section five, followed by a description of the empirical methodology used and an interpretation of the results. The paper ends with a general conclusion in section seven.

### 3 The Crisis of 2008 and its Effect on the Mexican Economy

In 2008 a global recession had its peak. Caused by this, trade collapsed and the demand for labor fell quickly. In 2009 the world was confronted with the biggest drop in production since the World War II, a fall in world trade for the first time in 27 years (The Mexican Secretariat of Finance and Public Credit, 2009), and with the largest drop in merchandise trade since World War II (Kaplan et al., 2011). This collapse in world trade during the third quarter of 2008 and the second quarter of 2009 was caused by a demand side shock<sup>1</sup> which had its origin in the postponing of purchases from European Union and U.S. firms and was consequently titled by Baldwin (2009) the "Great Trade Collapse".

Mexico was no exception and suffered enormously from the crisis because of its close link to the U.S. economy. During the crisis period, 80 percent of the Mexican exports were directed to the U.S. (Giri et al., 2012). Nowadays still 77.5 percent of Mexican exports are directed to the U.S. markets (The National Institute of Statistics and Geography (INEGI, Instituto Nacional de Estadística y Geografía), 2012). During the crisis there was a high correlation between the decline in Mexican trade and the decline of the U.S. GDP (Robertson, 2009). From 2008 to 2009 exports to the U.S. decreased by 20.8 percent as a result of a lower volume of manufactured exports (The Bank of Mexico, 2011) and real exports declined by 27 percent (Giri et al., 2012). Giri et al. (2012) find that the change in total exports is mostly explained by exporters' adjustment in export sales of the same product and only slightly by firm exits. They also find that the bigger exporters<sup>2</sup> suffered more during the crisis and that Mexico compared to its major trading partners in North America and Latin America suffered most from a decline in trade and GDP.

In terms of growth, recession in the U.S. economy was reflected in a slowdown of the Mexican economy. After having recorded a real annual growth of 4.2 percent in 2006 and 3.2

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<sup>1</sup>Giri et al. (2012) also examine additionally two different causes: credit constraints and vertical supply chains. They find that vertical supply chains explain why during the crisis mostly big exporters, which have a high fraction of maquiladora exports, suffered most.

<sup>2</sup>The size of an exporter is approximated by its total exports.



percent in 2007, in the third quarter of 2008 it was only 1.6 percent per year compared to the same period the year before (Cámara de Diputados, 2009) and negative quarterly variations during almost all 2009 (The Bank of Mexico, 2011). Similarly, the fall in labor demand in the United States, caused a decline in remittances to Mexico by Mexican workers in the U.S. and a wave of return migration. Simultaneously, the Mexican peso had been devalued against the dollar for 44.8 percent in five months, taking its lowest level of 9.87 pesos per dollar on August 4, 2008, from the level reached in intraday operations on January 15, 2009 from 14.30 pesos per dollar (The Mexican Secretariat of Finance and Public Credit (2009), The Bank of Mexico (2010)).

In figure 1 the percentage changes in the annual variation for the values are shown for different sectors. The negative percentage change was highest in the manufacturing industry and the commerce sector during 2009 until 2010 with almost 20 percent in the commerce sector at its lowest point in the second quarter of 2009 and almost 15 percent in the manufacturing industry in the same quarter. In figure 2 the absolute change in the number of employees for the data set in the different sectors is shown. On the peak of the crisis in the first quarter of 2009 the highest reduction of employment from one quarter to another was in the manufacturing and commerce sector followed by the construction and the services sector. In their paper on productivity differences between and within Mexican firms, Giri and Teshima (2013) find related to the impact of the trade shock of 2008 on employment that exporting plants suffered much more from the crisis than non-exporting plants.

## 4 Theoretical Model for the Impact of a Crisis on the Labor Market

Following Lilien and Hall (1986) the theory of cyclical movements in the labor market combines an economic mechanism with a driving force. The driving force can be misperception or a real shock. As the crisis of 2008 was to a large extent not anticipated and had its origin outside of Mexico, it can be interpreted as an exogenous shock and it can be used as a laboratory to investigate how negative economic shocks affect individuals and how they respond to those shocks<sup>3</sup>. This way, concerns of endogeneity because of an anticipation of the crisis and thus an anticipated adjustment of the behavior of the individuals can be excluded.

A common way to describe the movements in the labor market is to use the mechanism of the simple competitive labor market model, where wages and employment are defined by the intersection of the labor supply and the labor demand curves. At the equilibrium, the marginal value of labor in the production process is equal to the marginal value workers attribute to the second best alternative for their time. The already mentioned demand side shock (Baldwin, 2009) caused a reduction in the demand for labor which led to a downward shift of the labor demand curve and consequently to an increase in unemployment and a lower equilibrium wage. Additionally to that, according to McKenzie (2004), there is also a possible increase in labor supply, as consequence of the change in households' labor supply as the crisis forces households to substitute leisure for work and consequently send more household members to work, as the future conditions are uncertain and households could be faced with credit constraints (McKenzie, 2004). Furthermore in the Mexican case, one cannot exclude the returning migrants which augment the labor supply additionally. Supposing that the supply side effect is very little and a lot smaller than the impact on the demand of labor, the net effect of the crisis is an increase in unemployment and a lower equilibrium wage. If one considers the sectors separately one would expect that the demand for labor supply falls the most in the sectors that suffer from the largest production demand reduction during the crisis (McKenzie, 2004). Empirically there are various studies exploring the impact of crises

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<sup>3</sup>See Kaplan et al. (2011) for a broader explanation why the crisis can be considered as non-anticipated.

on labor markets. For the present investigation the following ones are the most important to obtain results for the impact of an aggregated shocks on the labor market.

#### **4.1 Evidence for the Impact of Crises on Labor Markets**

Kochar (1999) finds that men in rural India during a crop income shock tend to increase their labor hours in the market which he interprets as a desire of the household to smooth its consumption. The problem with this result is that the data set is very small and the author mentions the need of a confirmation of these results with a larger data set. In their study about the Indonesian financial crisis from 1998 Frankenberg et al. (2002) examine the impact of an unanticipated economic shock on wealth and welfare of individuals and how they respond to it. They focus on the different mechanisms households can employ to smooth out the impact of a crisis being one changes in the allocation of work effort. Their result for the reallocation of time to work or leisure during the financial crisis in Indonesia is that the total numbers of hours worked increased for all household members and that a worker per week worked ten hours more during the crisis. So even if real wages do not fall<sup>4</sup>, a way to deal with layed off household members is that others increase their work effort by working more hours or entering the labor market.

Considering the income effect, McKenzie (2004) investigates the impact of the Argentinian financial crisis on labor market outcomes. He focuses mainly on household welfare and on the short-term effect of the 2002 financial crisis. He finds a large aggregate effect, where 78 percent of the surveyed households suffer from an income decline. An important contribution is the decomposition of the overall change in the labor income of the households which is defined by the relative contributions of changes in wages, hours of work, job exit and job entry, and governmental work programs. The result is that the main component of the change of total households' labor income is a fall in real wages while only a little part of the loss is due to household members losing their job and that the households could not offset the falling real wages by having existing household members work more or sending more household members

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<sup>4</sup>As they are fixed by labour unions or by law or as the adjustment process did not start yet o will not because of the short term impact of a crisis.

to the labor market. This main channel of transmission is also found by Fallon and Lucas (2002) in their review of evidence of the impact of crises on labor markets, household income, and poverty. They find that during a crisis period in seven different countries, employment only fell considerably in Korea, while in Indonesia, Turkey, and Mexico employment rose whereas in Argentina, Malaysia, and Thailand the employment fell only by a small amount. They conclude that the main labor market effect of the crises in the 1990's was a reduction of the real consumption wages.

Contrary to these results, Kaplan et al. (2011) find that employment and not wages were more responsive in Mexico during the crisis of 2008. They show that the positive correlation between the exports from Mexico to the U.S. and Mexican employment was augmented during the crisis' period. They find a nine percent drop in formal employment from September 2008 to March 2009 in northern states and that the real wage only diminished minorly but still significantly. They also find that employment fell proportionally more in tradable-sectors than in non-tradables and that between the third and fourth quarters of 2008 mostly the lower-wage workers in the tradable sectors were laid off. The conclusion that the employment is more affected than the wage makes sense as a crisis is a short-term shock on the labor market and wages take some time to respond to the shock. They need more time than employment and consequently during a short term shock like a crisis one could suppose that the wage is not impacted a lot as the economy recovers before the wage responds to the shock<sup>5</sup>. The limitation Kaplan et al. (2011) paper is that they focus on formal employment only. They do not include the informal sector which in Mexico represents a large amount of the economically active population<sup>6</sup>. None of the authors does differentiate the impact between women and men, although McKenzie (2004) gives some results for men and women separately.

Although wages during a short-term shock will not be reduced drastically, the income of the economically active population can change due to lay-offs, short term wage reduction,

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<sup>5</sup>Normally wages are considered as 'sticky' as they respond slowly to changes in the economy. Specifically, wages are said to be "sticky-down" as they can easily increase but not decrease only with difficulty. This has its origin in labor unions, acceptance difficulties of employees, companies fear of bad press etc.

<sup>6</sup>The informal labor participation was 58.26 percent of the employed population in June 2013 (The National Institute of Statistics and Geography (INEGI, Instituto Nacional de Estadística y Geografía), 2013).

or a forced reduction of the hours worked which is a common way to deal with short term shocks particularly in the manufacturing sector. By focusing on the change in income, I can distinguish between the total income shock, whether through real income falls or through loss of job, and an income shock caused only by an income reduction.

## **4.2 Differentiation of the Impact of Crises between Women and Men**

Women are commonly considered as a group of society that is more vulnerable to exogenous shocks and even more the subgroup of single mothers. It is therefore of particular interest, if a crisis like the one of 2008 affects women more than men and if so in what magnitude. Antonopoulos (2009) states that in the midst of the financial crisis of 2008 there was a grave concern that progress made in poverty reduction and women's equality would be reversed. Her paper explores paths of transmission through which a crisis can affect women's world of work and overall well-being. Her argument is that as demand for textile and agricultural exports decline, along with tourism, job losses are expected to rise in these female intensive industries. As the paper was written during the middle of the crisis, Antonopoulos does not give any numerical results. In their study about the consequences of the Asian crisis Knowles, Pernia and Racelis (1999) find in relation of gender and crisis that the gender impact of the crisis on employment and earnings is not that clear. In Thailand for example the female employment declined by 3.8 percent between August of 1997 and 1998, compared to 2.5 percent among males. However there was no significant gender difference in unemployment rate increases and the decline in real earnings was less among female workers (the earnings gap between male and female earnings declines by 5.5 percent). For Indonesia they found that the real average earnings of female workers declined less than those of male workers in urban areas, but the reverse was the case in rural areas. They conclude that women (and female-headed households) have generally been harder hit by the employment and income impact of the crisis in Korea, Malaysia, Philippines, and Thailand, but less clearly so in Indonesia. Saget and Yao (2012) discuss the impact of the crisis of 2008 on economies and

labor markets of ten African countries from 2008-2009 but have employment numbers only for two countries disaggregated by gender (Egypt and Nigeria). They find that the situation of women deteriorated in the labor market, while that of men improved and conclude that it seems to be a kind of inverted added worker effect. For the Mexican crisis of 1995, Cunningham and Maloney (2000) measure the vulnerability of Mexican households and distinguish between female headed households and income quantiles and conclude that female headed households suffered more during the crisis. In general, evidence that distinguishes the impact of crises between women and men is rare.

Supplementary to the little evidence, standard trade theory gives an idea how the crisis could impact differently the individuals depending on their gender, interpreting the crisis in the Mexican case as a contraction of trade: There are typically three reasons that argument for a reduction of the gender wage gap caused by trade liberalization. First, according to Becker (1971), globalization leads to a higher level of competition which makes it more costly for firms and individuals to discriminate. Second, increasing trade will augment the job opportunities and so the export-oriented industries will absorb more women (Wood, 1991). The third argument is that increasing trade will stimulate economic growth, which will lead to higher levels of income for households and a reduction in human capital disparities and therefore the gender gap as well (The World Bank, 2001). It is difficult to make a general conclusion about the impact of trade on the gender wage gap, but Fontana (2003) suggests that pure discrimination seems to decline while the gap due to occupational segregation has been widening. For the Mexican case this is confirmed by Calónico and Ñopo (2008).

Consequently the resulting hypothesis is that a negative trade shock like the trade crisis of 2008 should lead to opposite outcomes: 1. More discrimination against women as the level of competition is reduced; 2. Less job opportunities for women as the export-oriented industries have a lower demand for labor force; 3. By a reduction of trade there is less economic growth which leads to lower income levels for the households and consequently less investment in the human capital of women.

As already mentioned, only few studies provide evidence for a short term exogenous

shock like the crisis of 2008 separated for women and men and as far as I know none for the Mexican case. So as we know a lot more about the impact of trade as a positive shock in the long run, we do not know about the impacts of a negative trade shock in short term and its implications on the gender income differential. This lack of knowledge must be filled as one cannot automatically conclude the opposite implications as trade agreements have long-term effects and are anticipated, while a crisis is a short-term event and can have different implications.

## 5 Data

The data used is from the Mexican Survey of Occupation and Employment (ENOE) ranging from the third trimester of 2006 until the first of 2012. The aim of the ENOE is to obtain information on the occupational characteristics of the Mexican population and other demographic and economic variables that allow a deeper analysis of the labor aspects. The ENOE survey has been conducted every three months since 2005 by the Mexican Institute of Statistics and Geography (INEGI) and is the largest continuously raised survey for households in Mexico. It represents the consolidation and fusion of the National Urban Employment Survey (ENEU) and the National Employment Survey (ENE). For the economic characteristics, data is captured of the population 12 and older, but I only include individuals from age 14 to age 65. The survey covers a random sample of approximately 150,000 households and each household remains in the survey for five consecutive quarters, so the most a household stays in the survey is one year and three months. I reduce the data set by the population that is economically not active so only employed and unemployed individuals remain in the data set. Altogether I have a number of 3,903,218 observations for the total of 23 quarters. The almost 4 million individual observations are then aggregated by state<sup>7</sup>, year, gender, and sector, depending on the regressions used. An important advantage of this data set is that formal and informal employed individuals are represented. Data on the gross domestic product (GDP) by sector is from the Mexican Institute of Statistics and Geography (INEGI). GDP by sector is given as the annual percentage variation of the values at 2008 prices. Appendix B, table 1, shows the variables used and table 2 shows some basic information of unemployed and employed men and women in the different quarters.

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<sup>7</sup>ENOE is only representative on state level.



## 6 Empirical Methodology

The objective of this investigation is to find out whether the crisis had an impact on the income and worked hours of Mexican individuals, and if so, if women were more affected than men. Ideally one would compare two regions with the same characteristics, with the only difference that one was impacted by the crisis and the other one not. The resulting difference in the dependent variables could be attributed to the crisis. This would be a perfect experiment, but as this is not possible in this scenario, we can use econometric techniques that can give us a reasonable estimation of the actual effects.

The method of differences-in-differences (DID) compares the change in an outcome variable before and after an event between two groups: one that was affected by an event and another that wasn't. In this case, the affected group (treatment group) is composed by the individuals that live in states that were particularly affected by the crisis of 2008, while the control group corresponds to individuals inhabiting states that were not affected by this event. DID assumes that there is an unobserved time invariant heterogeneity present. This fixed component can be canceled out by differencing with a data set that ranges from before to after the event and has control observations. With this data the difference is calculated between the observed mean outcomes before and after the event happened for the treatment and control groups. Like this, the real impact of the event is the only residual that remains and heterogeneity which is unobserved or impossible to measure, like differences in personality or innate ability that can be responsible for different outcomes, are differenced out. The important assumptions are that the unobserved heterogeneity is time invariant and uncorrelated with the event over time. Consequently DID resolves the problem of missing data as outcomes for affected and non-affected individuals in periods before and after the event are measured. This removes biases in second period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of trends.

Given a two-period setting the DID method will measure the impact of an event as follows:

$$DID = E(Y_1^T - Y_0^T | T_1 = 1) - E(Y_1^C - Y_0^C | T_1 = 0) \quad (1)$$

Where  $t = 0$  denotes before the event and  $t = 1$  after the event,  $Y_t^T$  and  $Y_t^C$  the respective outcomes of the treated and the nontreated units,  $T_1 = 1$  the treated areas and  $T_1 = 0$  the nontreated areas. Using DID and assuming that the unobserved heterogeneity is time invariant and uncorrelated with the event over time, one can measure the real impact, as biases are removed that could be the result of permanent differences between the treatment and control group, as well as biases from comparisons over time that could be the result of trends.

To have a causal statement of the impact on the crisis on income and worked hours, two assumptions have to be fulfilled. The first is that the event had no effect on the variables of interest in the control region. The second assumption in DID is the parallel trend assumption so that the treatment effect is the difference between the observed value of  $y$  and what the value of  $y$  would have been with parallel trends if there had been no treatment. The assumption here is that, in the absence of the crisis, the average difference between the outcome variables across states with and without an impact of the crisis would be the same after or before the crisis. So the assumption is that variables can differ in levels across states with and without crisis' impact, but they cannot differ in changes which implies that differential changes in the outcome variables wouldn't have happened in the absence of the crisis.

To include the regional disparities and obtain the control group, I arrange the 32 states in four different regions based on export performance<sup>8</sup>: the northern region is composed by the export oriented and U.S. bordering states, central states are grouped in the central region with the exception of Mexico City, Guadalajara, and Mexico State, which constitute their own group. The southern states will serve as control group. To fulfill the first assumption, the DID approach requires that the crisis, during which mainly the trade sector suffered

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<sup>8</sup>Dell (2005) uses this sorting in her paper "Widening the border" based on data from the Secretary of Commerce and Industrial Development (now part of the Secretary of Economy - Secretaría de Economía) and from the Bank of Mexico (Banco de México).

(as already mentioned in section three), had no effect on the income and employment variables in the south. There is a lot of evidence on the impact of trade liberalization on the different regions in Mexico. Mainly they find that there is a connection between trade liberalization and economic divergence which leads in the case of Mexico to an increase of the gap between the relatively rich north and an increasingly poor south (Rodríguez-Pose and Sánchez-Reaza (2003), Rodríguez-Pose and Gill (2003), Gonzalez Rivas (2007), Dell (2005), Aroca et al. (2005), Hanson (1996), Hanson (1998)). Between 1994 and 1999 the states in the south of Mexico only produced 5 percent of total non-maquila exports and less than 1 percent of maquila exports and also receive less Foreign Direct Investments (FDI) compared to northern states (Dell, 2005). This result has different origins like a dominance of agricultural self-subsistence, distance to important ports, high rate of indigenous population, and others (Moreno-Brid and Ros, 2009). The consequence is a poorly integrated south with little export-competing industry, and that is, as a consequence, less impacted by trade liberalization.

As the sectors in Mexico affected the most by the crisis of 2008 were the sectors with deep connections to international trade (see section three), the crisis can be interpreted as a contraction in trade. As the southern states were not impacted by trade liberalization during previous decades, they are also not impacted by the crisis as are the rest of the states, in which trade increased largely during the 90's trade liberalization and consequently these states were largely affected negatively by the crisis. Moreover figures 3 to 8 show the evolution of employment and unemployment in percentage of the total economically active population from the third quarter of 2006 to the first quarter of 2012 separately for women and men and for the different regions. Figures 3 to 8 show the behavior of the curves that describe the development of employment (unemployment) in the treatment and control states from the third quarter of 2006 to the first quarter of 2012. Comparing women and men in the treatment and control area in figure 3, the men's control curve shows the behavior desired for a control group (the curve shows no special impact of the crisis compared to the treatment curve), while considering the women's curves (control and treatment), both curves have a

steep fall of employment during the time of the crisis and move almost parallel. Thus, one could argue that for the female population the control group does not fulfill the second assumption and the impact of the crisis is underestimated in the results for women.

Dividing the states that are not in the south in the three groups of central, north and DF/Jalisco, figures 5 and 6 show the development of employment and unemployment for the female population and it is clear that starting from a similar employment rate in 2006 (where the south interestingly has the highest value), the percentage points decrease in employment from the third quarter of 2008 to the third quarter of 2009 is highest in the north with over four percentage points, followed by the DF/Jalisco region with a decrease of around 2.5 percentage points. The unemployment curves show the reverse relationship. In figures 7 and 8 the same pattern can be observed for the male employment and unemployment. The curves in the treatment areas are much more steeper than in the control area and the northern and DF/Jalisco states have higher levels of decrease in the employment rate and increase in the unemployment rate respectively.

The second assumption in DID is the parallel trend assumption which means that the differential changes in the outcome variables wouldn't have happened in the absence of the crisis. Consequently it assumes that unobserved characteristics which could affect being in the crisis impacted area do not change over time. There should not be a higher level of intra migration from the south (control state) to the other states during the crisis as the crisis was unanticipated, which means that individuals couldn't move before the crisis to avoid the negative impact of the crisis or change their habits. One of the concerns often mentioned in relation with this assumption is that the event or the intervention has to be exogenous to have valid estimates of an impact<sup>9</sup>. The exogeneity issue is widely discussed and confirmed by Kaplan et al. (2011). What could have happened is an augmentation of intra migration caused by the drug war that had its peak during the same period. This could be confirmed by the Mexican Family Life Survey (ENNViH) but the data for 2009 wasn't available at the time of this analysis.

I control in the most accurate way for unobserved heterogeneity by using state and time

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<sup>9</sup>See Besley and Case (2000) for a wider analysis.

fixed effects<sup>10</sup> and when possible by the interaction of states and quarters<sup>11</sup>. This way the effects, particular to each state and to each quarter, can be absorbed. Formally I control for the average differences across states and quarters in any observable or unobservable predictors. So the fixed effects control for all across-group action.

A common assumption of consistent estimators is that the error term in the regression model is independently and identically distributed but this can be violated in many cases for example if the observations within a state are correlated in some unknown way. A generalization is then to assume the errors are clustered. The fact that the error terms are clustered means that the observations within a group (in this case within a state) are correlated with each other, and so, the error term is correlated within each state but still uncorrelated across different states. Although the estimates are unbiased, the standard errors may be quite wrong. This serial correlation can lead to an understatement of the standard deviation of the treatment effect and so to an over-estimation of significance levels (Bertrand et al., 2002). By clustering one obtains standard errors that are robust to both: heteroskedasticity and intra-group correlation (Stock and Watson, 2006). Therefore, for all regressions, by clustering the errors by state I can correct for this potential serial correlation. In conclusion, I address the correlation left over from the inclusion of state and time fixed effects by clustering standard errors.

## **6.1 Regression Model for the Impact of the Crisis on Income and Worked Hours**

First I want to investigate if there was an impact of the crisis on the economically active population in the states that are not in the south. Therefore I use an interaction between the group of states that are not situated in the south and a crisis dummy. I control by state and time fixed effects. Column (1) of table 3 gives the results of the following regression for natural log Income as dependent variable and columns (3) of the same table give the results

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<sup>10</sup>Would I use only two periods, the results for the DID and the FE would be the same.

<sup>11</sup>This depends on the level of aggregation. When the data is aggregated on state, quarter, and sector (gender) level, the interaction between state and quarter is also used as a control.

for the following regressions for the worked hours of a week:

$$W_{sit} = \beta_0 + \beta_1 \text{notsouth}_s \text{crisis}_t + \omega_0 S_s + \rho_0 T_t + \varepsilon \quad (2)$$

The term on the left hand side is the mean natural log income in state  $s$  in quarter  $t$  for the economically active Mexican population and only the employed population respectively,  $\text{notsouth}_s$  is a dummy variable equal to 1 if the state was affected by the crisis and zero if not (control states),  $\text{crisis}_t$  is a dummy variable equal to 1 if the observation occurred during the crisis definition, from the first quarter of 2009 to the first quarter of 2010,  $S_s$  is a vector of state fixed effects which captures differences between the different states, and  $T_t$  which is a vector of time fixed effects.

All results include the formal and informal population. This is one of the main contributions of this analysis, because although 60 percent of the economically active population is in this condition, informal workers have been left out of previous studies of this kind. Table 3 has as a universe the whole economically active population which includes employed and unemployed while table 4 shows the same regressions but only includes the employed population. Therefore table 4 shows the impact of the crisis on the mean log income (worked hours) by a change of the wage (change of the worked hours) of the employed population while table 3 shows the impact on the whole economically active population as it includes the impact of the crisis on the income (worked hours) because of a wage reduction (reduction of the worked hours caused by crisis handling of companies) and because of dismissals. Consequently, the first column of table 3 shows the impact of the crisis on the mean log of income and worked hours, directly on income and hours worked, and indirectly by a decrease of employment while table 4 shows the direct impact on the income and worked hours of the formal and informal employed population. I can therefore distinguish between the total income shock, whether through real income falls or through loss of jobs, and an income shock caused only by an income reduction.

The Mexican states bordering with the United States are the ones which are highly specialized in export production therefore northern states should suffer more from a crisis.

Consequently, as different regions in Mexico should be affected differently by the crisis because there are regions that are more export oriented than others, I grouped the states in four different regions as mentioned above, depending on their exposure to trade<sup>12</sup>. This way I can obtain the impact of the crisis separated by region. Columns (2) and (4) of table 3 and 4 show the results of the following regression:

$$W_{sit} = \beta_0 + \beta_1 DFJalisco_s crisis_t + \beta_2 central_s crisis_t + \beta_3 north_s crisis_t + \omega_0 S_s + \rho_0 T_t + \varepsilon \quad (3)$$

where  $DFJalisco_s$  is a dummy variable equal to 1 if state S is the Federal District, Mexico State, or Jalisco,  $central_s$  is a dummy variable equal to 1 if state S is one of the central states, and  $north_s$  is a dummy variable equal to 1 if state S is in the north. The other terms are as explained for equation (2) and  $W_{sit}$  is ln income for column (2) in table 3 and 4 and worked hours for column (4) in table 3 and 4.

### 6.1.1 Results for the Impact of the Crisis on Labor Income and Worked Hours

Table 3 shows the results of equations 2 and 3 for the impact on the income for the whole economically active population (unemployed and employed population). The interaction term  $notsouth_s crisis_t$  is highly significant at a 1 percent level and has a negative sign, indicating that the crisis had a negative impact on the income of the economically active population of 15 percent.

As already mentioned, Mexico is very diverse regionally in its production pattern and different regions are exposed differently to trade, and so, its export oriented production. The states in the north of Mexico on the border to the United States are highly specialized in export production and so one would suppose a higher negative impact in that region. This hypothesis is verified by the results as the individuals in the northern states suffer from an labor income reduction of 23 percent while the central states compared to this only suffer from a 12 percent reduction and the metropolitan areas of DF, Mexico State, and Jalisco

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<sup>12</sup>See Appendix B to see the group members enlisted and Dell (2005) for a justification of the grouping.

suffer from a 14.5 percent reduction, all significant at the 1 percent level. This seems at first a considerably high reduction but one has to have in mind that the data includes the employed and unemployed population. Thus, this reduction of the monthly income includes not only the reduction the employed population suffered, if not also the income reduction suffered by layoffs, which is the income change caused from being employed to getting unemployed. Also the fall in the Mexican GDP was around 6.5 percent from 2008 to 2009 which is very large and so the large decrease in income is not out of range.

Column (3) and (4) confirm that during the crisis not only the labor income was reduced but consequently also the hours worked. For the interaction term  $notsouth_scrisis_t$  the results are also highly significant and indicate that during the crisis in the states that are not in the south, the worked hours were reduced by 0.8 hours (48 minutes) a week. The results follow the same pattern as before considering the regional interaction terms  $DFJalisco_scrisis_t$ ,  $central_scrisis_t$ , and  $north_scrisis_t$ . The highest reduction in the hours worked per week can be observed in the northern states (1.4 hours), followed by the metropolitan area with 0.7 hours and the central area with a reduction of the hours worked of 0.6 hours. These results again include not only the reduction in the hours worked of the employed population but also the reduction lived by the unemployed by experiencing the change from being employed to getting unemployed.

For table 4 the data only contains the employed population. Therefore the reductions in the income and the worked hours are lower than in table 3 as the impact of the crisis on the income and the worked hours was reduced by the exclusion from the observations of the unemployed population. The result for the interaction term  $notsouth_scrisis_t$  indicates for the income of the employed population in the states that are not in the south that there was a 9 percent reduction during the crisis and that the hours worked were reduced by 0.45 hours (27 minutes). So half of the reduction of the hours worked per week and 6 percentage points of the change in the labor income can be explained by the individuals that got unemployed during the crisis. Considering the regional interaction terms for the DFJalisco region 3.5 percentage points of the reduction in the labor income can be explained by the individuals that lost their



job, for the central 4 percentage points, and for the northern region 11 percentage points. As a result in the northern states almost half of the income reduction can be explained by the loss of jobs, while in the central and metropolitan region it makes only around a third and a quarter respectively. The impact on the worked hours is for the three regions halved. All results are highly significant.

## **6.2 Regression Model for the Impact of the Crisis with Sector Distinction**

As mentioned in section four, one would suppose that the individuals in the manufacturing and commerce sector, the two sectors that had the highest reduction in GDP during the crisis and laid the most people off, would also suffer from a higher income reduction than individuals in other sectors. It therefore makes sense to distinguish the employed population by their sector with the purpose of investigating the impact of the crisis on the labor income and worked hours of the individuals working in the sectors that were mostly affected by the crisis. Another outcome could be that the high layoff rates in these sectors happened to avoid the need to reduce wages of the employed individuals in these two sectors, as it is at least for the manufacturing sector a common way to deal with cyclical shocks to make short term layoffs and hire again after the end of a recession. By focusing on the two sectors manufacturing and commerce I also include in the analysis that the employment structure can differ in sectors within the different regions like a higher employment in the agricultural sector in the southern regions which has a typical cyclical hiring behavior depending on the season of the year.

The purpose is to obtain the impact of the crisis on labor income and worked hours in the sectors which should primarily be affected from the crisis. For this reason I use a triple interaction approach which compares the labor income (worked hours) of individuals employed in the manufacturing (commerce) sector with individuals not being employed in the manufacturing (commerce) sector in crisis-impacted and non-crisis-impacted states, during the crisis and after/before the crisis.

Table 6 shows the results for equation 4 and table 7 the regression extended by the regional dummies instead of the *notsouth* dummy.

$$\begin{aligned}
W_{sit} = & \beta_0 + \beta_1 \text{notsouth}_s \text{crisis}_t \text{manufacturing}_i + \beta_2 \text{notsouth}_s \text{crisis}_t \text{commerce}_i \\
& + \beta_3 \text{notsouth}_s \text{crisis}_t + \beta_4 \text{notsouth}_s \text{commerce}_i + \beta_5 \text{notsouth}_s \text{manufacturing}_i \\
& + \beta_6 \text{manufacturing}_i + \beta_7 \text{commerce}_i + \beta_8 \text{commerce}_i \text{crisis}_t \\
& + \beta_9 \text{manufacturing}_i \text{crisis}_t + \sigma_0 S_s T_t + \omega_0 S_s + \rho_0 T_t + \varepsilon
\end{aligned} \tag{4}$$

### 6.2.1 Results for the Impact of the Crisis on Labor Income and Worked Hours with Sector Distinction

The manufacturing and the commerce sector were the two sectors, as shown in figure 3 and 4, that experienced the largest change in quarterly GDP and employment during the crisis. It is now to be shown if with the lay-offs, which is a typical manner in the manufacturing industry to deal with recession, was enough to handle the negative impact of the crisis or if also the labor income of the individuals remaining in the manufacturing and commerce sector were affected. By separating the impact on the sectors that were mostly affected by the crisis, I exclude the possibility that there was a negative impact of another origin which could have happened during the same period and I also take into consideration that the regions are differently structured in their distribution of the working population across the different sectors.

For table 5 to 7 the data set of only the employed was used and aggregated by quarter, state, and sector (manufacturing, commerce and other). Aggregating like this can only be made for the employed population because if one would aggregate over the whole economically active population, all the unemployed individuals would automatically be grouped as neither in the manufacturing sector nor in the commerce sector and like this bias the result. Table 5 shows the results for the previous regressions 2 and 3 but with the mentioned aggregation form to test for if the aggregation level influences the results. The results do not differ in signs and are similar in size although higher than the previous results.

In table 6 the results for the triple interactions terms  $notsouth_scrisis_tmanufacturing_i$  for the manufacturing sector, and  $notsouth_scrisis_tcommerce_i$  for the commerce sector, are shown. Both have a positive sign for the impact on income and worked hours but only for the commerce sector the impact is significant. The triple interaction terms capture how the impact of the crisis is different for the manufacturing and commerce sector compared to the other sectors. For the manufacturing sector,  $notsouth_scrisis_tmanufacturing_i$  captures how the impact during the crisis is different for individuals working in the non-southern states in the manufacturing sector compared to other sectors (non manufacturing and non commerce), while for the commerce sector,  $notsouth_scrisis_tcommerce_i$  captures how the impact during the crisis is different for individuals working in the non-southern states in the commerce sector compared to other sectors (non manufacturing and non commerce).

The interaction term  $notsouth_scrisis_t$  has a negative sign at a highly significant level. Working individuals living in the states that are not in the southern region of Mexico experienced during the crisis a labor income reduction of 15 percent and a reduction of the worked hours of 0.89 hours (53 minutes). Consequently, as the negative value of the interaction term  $notsouth_scrisis_t$  is larger than the triple interaction term for the commerce sector ( $notsouth_scrisis_tcommerce_i$ , for the manufacturing sector the results are not significant), the labor income and worked hours of individuals in the manufacturing sector was not reduced more than in other sectors, while individuals working in the commerce sector in the non-southern region suffered less than other working individuals, though they still suffered, as 0.075-0.154 is still negative. So while workers in other sectors (including the manufacturing sector), experienced an income reduction of 15 percent, the workers in the commerce sector suffer only from a reduction of 8 percent.

This is contrary to the expectation of the impact on individuals working in the two sectors that experienced the largest change in quarterly GDP and employment during the crisis as the results implicate that the workers in the manufacturing and commerce sector did not suffer more than workers in other regions and workers in the commerce sector suffered even less. One explanation lies in the fact of the high dismissals in these two sectors. Short-term

lay-offs are a common behavior to react to a recession, especially in the manufacturing sector. It is therefore possible that the impact of the crisis was absorbed by the lay-offs and income reduction, not more than in other sectors (and in the commerce sector even less), were not necessary<sup>13</sup>.

Regarding table 7, were I used instead of the notsouth-dummy the regional dummies, the triple interaction terms are not significant for the labor income and only some results for the triple interaction terms of hours worked are significant ( $DFJalisco_scrisis_tmanufacturing_i$ ,  $DFJalisco_scrisis_tcommerce_i$ , and  $north_scrisis_tcommerce_i$ ). For all the triple interaction terms, the sign is positive with the exception of the interaction term for labor income as a dependent variable for  $central_scrisis_tmanufacturing_i$  (although not significant). As for the results of table 6 (where notsouth instead of the regions is used), the interaction terms between the regions and crisis are highly significant with a negative sign for labor income and worked hours.

Although the negative values for worked hours of the interaction terms  $DFJalisco_scrisis_t$ ,  $central_scrisis_t$ , and  $north_scrisis_t$  are larger than the positive significant values of the triple interaction terms for the worked hours of individuals in the Metropolitan region in the manufacturing and commerce sector and individuals in the northern states in the commerce sector, in the case of the individuals in the commerce sector in the Metropolitan region and the northern states, the negative impact on the worked hours is very little ( $1.087 - 1.141 = -0.054$  in the case of  $DFJalisco_scrisis_tcommerce_i$  and  $1.035 - 1.072 = -0.037$  in the case of  $north_scrisis_tcommerce_i$ , both values correspond to less than 5 minutes). Consequently although all individuals suffered from a labor income and worked hours reduction in all non southern regions, individuals in the manufacturing sector in the Metropolitan area suffered less and individuals in the commerce sector in the Metropolitan region and the northern states, did only experience a very small impact on their worked hours.

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<sup>13</sup>This could be tested by a probit which tests the probability of being employed during the crisis in the different sectors for the states that are not in the south.

### 6.3 Regression Model for the Distinction of the Impact of the Crisis between Mexican Women and Men

Did the crisis affect Mexican women's income more than man's? The Difference-in-Difference-in-Difference (DDD) approach compares the income of women with the income of men in crisis-impacted and non-crisis-impacted states, during the crisis and after/before the crisis. Columns (1) and (2) of table 8 and 9 give the results for the following regression for the unemployed and employed population:

$$\begin{aligned}
 W_{sit} = & \beta_0 + \beta_1 \text{notsouth}_s \text{crisis}_t \text{female}_i + \beta_2 \text{notsouth}_s \text{crisis}_t \\
 & + \beta_3 \text{crisis}_t \text{female}_i + \beta_4 \text{notsouth}_s \text{female}_i \\
 & + \text{female}_i + \sigma_0 S_s T_t + \omega_0 S_s + \rho_0 T_t + \varepsilon
 \end{aligned} \tag{5}$$

Where  $\text{female}_i$  is a dummy variable equal to 1 if the individual is female, and the other variables are defined as before.

Columns (3) and (4) of table 8 and 9 give the results of the following regression:

$$\begin{aligned}
 W_{sit} = & \beta_0 + \beta_1 \text{DFJalisco}_s \text{crisis}_t \text{female}_i + \beta_2 \text{central}_s \text{crisis}_t \text{female}_i \\
 & + \beta_3 \text{north}_s \text{crisis}_t \text{female}_i + \beta_4 \text{crisis}_t \text{female}_i + \beta_5 \text{region}_s \text{female}_i \\
 & + \beta_6 \text{region}_s \text{crisis}_t + \text{female}_i + \sigma_0 S_s T_t + \omega_0 S_s + \rho_0 T_t + \varepsilon
 \end{aligned} \tag{6}$$

Where  $\text{region}_s \text{female}_i$  is an interaction vector of the different regions and the female dummy, and  $\text{region}_s \text{crisis}_t$  is an interaction vector of the different regions and the crisis dummy. The other variables are as defined before.

### 6.3.1 Results for the Distinction of the Impact of the Crisis between Women and Men

As described in the previous section, the impact of the crisis on women and men is not clear and we do not know much about the Mexican case. Therefore it is important to contribute to the lack of knowledge by finding out if women experienced a greater impact of the crisis, as this should be taken into account while implementing counter cyclical shock policies.

The result for the triple interaction term ( $notsouth_scrisis_tfemale_i$ ) of equation (4) shown in table 8 is for the dependent variable *Income* and *Hours worked* positive and statistically significant at a 1 percent level for the whole economically active population. The coefficient for income in the treatment area is almost 15 percent and for worked hours 0.93 per week. As the coefficient  $notsouth_scrisis_t$  is negative and highly significant and larger, women also experienced a negative impact on their income and worked hours during the crisis, but they suffered less than men. Additionally the coefficient *female* is negative at the 1 percent level and has a size of almost 30 percent. Consequently, during the crisis, women still earned less than men, but the difference between Mexican women and men was reduced during the crisis, but Mexican women and men suffered from a negative impact of the crisis on their income and worked hours<sup>14</sup>. This outcome could have different origins: First, one could suppose as mentioned above, that one way to deal with the short term impact of the crisis of the households, was to send family members to work, that in non-crisis-periods have no need to contribute to the households' income. Second, relatively more men were dismissed during the crisis period than women and as a consequence the difference between the incomes was reduced<sup>15</sup>. Additionally to that, women in the southern region suffered more during the crisis as the interaction term  $crisis_tfemale_i$  is negative and highly significant for the labor income and worked hours. Thus women in the southern states not only suffer from an income difference compared to male individuals, but also from a worsening of this difference during the crisis.

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<sup>14</sup>This result is in line with the findings of Knowles (1999).

<sup>15</sup>This could be tested by a probit which tests the probability of being employed for women and men during the crisis for the states that are not in the south.

For the results of table 9, only the employed population was used as a universe and as a consequence the triple interaction term ( $notsouth_scrisis_tfemale_i$ ) of equation (4) is still positive and highly significant, but also larger by 2.5 percentage points. This means that the income difference between women and men is less when only the employed population is considered than when the whole economically active population is used as universe. Consequently the interpretation is that on average the income difference between women and men was reduced even more for employed women than for the whole economically active population during the crisis. This could be because women that entered the labor force during the crisis entered in jobs that were higher paid than on average before the crisis, or because employed men that changed to jobs paying less than average. There is also the possibility of an income increase for women relative to men because of a wage increase for women, but as far as I know there was no policy or other reason during the time of the crisis which would have induced this. Again the interaction term  $crisis_tfemale_i$  is negative and highly significant for the labor income and the worked hours and similar in amounts. Consequently the impact of the crisis on the income and worked hours of women in the southern areas can only explained very little by more dismissals than men.

Regionally, this impact was highest in the north, which supports the interpretation of the north being the region which experienced the highest impact of the crisis due to its close link to the economy of the United States by trade. Subsequently, unemployed individuals are excluded from the universe and as a result the triple interaction term ( $notsouth_scrisis_tfemale_i$ ) although still positive and highly significant is less. This is also the case for the regional triple interaction terms. As before, the hours worked also increased significantly for the notsouth area and for all regions but again less than before.

## 6.4 Differentiating the Impact of the Crisis for Women and Men in the Manufacturing and Commerce Sector

As mentioned before the manufacturing and the commerce sector experienced substantial negative impacts during the period of the crisis. In the Mexican case, these two sectors

represent a large amount of the women work force. Figures 9 and 10 show the absolute number of Mexican women and men and the relative number respectively in the two sectors. More than 25 percent of Mexican employed women work in the commerce sector and around 15 percent in the manufacturing sector. Together more than 40 percent of the Mexican employed women work in one of these sectors while only 30 percent of Mexican men work in one of these sectors. Consequently in the Mexican case these two sectors can be considered as female intensive and therefore it is of interest if Mexican women during the crisis working in one of these sectors experienced a negative impact compared to men or not.

The results for the following regression with quadruple interaction terms are enlisted in table 10 for the dependent variable income and worked hours.

$$\begin{aligned}
W_{sit} = & \beta_0 + \beta_1 \text{notsouth}_s \text{crisis}_t \text{female}_i \text{commerce}_i + \beta_2 \text{notsouth}_s \text{crisis}_t \text{female}_i \text{manufacturing}_i \\
& + \beta_3 \text{notsouth}_s \text{crisis}_t \text{female}_i + \beta_4 \text{notsouth}_s \text{female}_i \text{commerce}_i + \beta_5 \text{notsouth}_s \text{crisis}_t \text{commerce}_i \\
& + \beta_6 \text{crisis}_t \text{female}_i \text{commerce}_i + \beta_7 \text{notsouth}_s \text{female}_i \text{manufacturing}_i \\
& + \beta_8 \text{notsouth}_s \text{crisis}_t \text{manufacturing}_i + \beta_9 \text{crisis}_t \text{female}_i \text{manufacturing}_i \\
& + \beta_{10} \text{notsouth}_s \text{crisis}_t + \beta_{11} \text{crisis}_t \text{female}_i + \beta_{12} \text{notsouth}_s \text{female}_i \\
& + \beta_{13} \text{notsouth}_s \text{commerce}_i + \beta_{14} \text{notsouth}_s \text{manufacturing}_i + \beta_{15} \text{crisis}_t \text{commerce}_i \\
& + \beta_{16} \text{female}_i \text{commerce}_i + \beta_{17} \text{crisis}_t \text{manufacturing}_i + \beta_{18} \text{female}_i \text{manufacturing}_i \\
& + \beta_{19} \text{female}_i + \beta_{20} \text{commerce}_i + \beta_{21} \text{manufacturing}_i \\
& + \sigma_0 S_s T_t + \omega_0 S_s + \rho_0 T_t + \varepsilon
\end{aligned} \tag{7}$$

#### 6.4.1 Results for the Impact of the Crisis for Women and Men in the Manufacturing and Commerce Sector

Table 10 shows the results for the quadruple interaction terms of women during the crisis in the non-southern region in the manufacturing and commerce sector. Again for the sector focused analysis only the employed population was used as a universe and aggregated by



quarter, state, female, and sector (manufacturing, commerce and other). Like before, the interaction term  $notsouth_scrisis_t$  is highly significant and negative and has a absolute value of 17.2 percent for the impact on income (0.96 for worked hours respectively), while the triple interaction term  $notsouth_scrisis_tfemale_i$  has a positive sign and is highly significant at the 5 percent level with a value of 11.9 percent (0.78 for worked hours respectively). Thus, Mexican women and men suffered during the crisis but women suffered less and as a result the income difference between women and men was reduced as found by Knowles (1999) for Indonesia during of 1997. As in section 6.2  $notsouth_scrisis_tmanufacturing_i$  and  $notsouth_scrisis_tcommerce_i$  have a positive sign but contrarily to before, the triple interaction term for the manufacturing sector is significant, while the triple interaction term for the commerce sector is not. So although suffering from the crisis, as the absolute value of  $notsouth_scrisis_t$  is larger than  $notsouth_scrisis_tmanufacturing_i$ , men in the manufacturing sector suffered during the crisis less than men in other sectors.

The quadruple interaction term  $notsouth_scrisis_tfemale_imanufacturing_i$  which captures the impact of the crisis on Mexican women in the manufacturing sector in the non-southern region, is negative and highly significant<sup>16</sup>. So while men in the manufacturing sector, compared to other sectors suffered significantly less, women in the manufacturing sector in the northern region suffered more than women in other sectors during the crisis from an income reduction<sup>17</sup>. Thus, although women in general experienced a smaller impact on their income during the crisis, women in the manufacturing sector suffered more than women in others sectors. Consequently, women in the manufacturing sector, not only suffered from the general income reduction but suffered even more than women in other sectors.

## 6.5 Regression for the Impact of the Crisis on Labor Income and Worked Hours of Single Mothers

Cunningham and Maloney (2000) find that single mothers were less vulnerable during the

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<sup>16</sup>For the quadruple interaction term of the commerce sector, the term is also negative but very small and statistically not significant.

<sup>17</sup>For worked hours the result is not statistically significant.

Mexican crisis of 1995 than other groups. This result is contrary to the commonly expected as single women are normally considered as highly vulnerable to exogenous shocks like a crisis.

$$\begin{aligned}
W_{sit} = & \beta_0 + \beta_1 \text{notsouth}_s \text{crisis}_t \text{singlemother}_i + \beta_2 \text{notsouth}_s \text{crisis}_t \\
& + \beta_3 \text{crisis}_t \text{singlemother}_i + \beta_4 \text{notsouth}_s \text{singlemother}_i \\
& + \text{singlemother}_i + \sigma_0 S_s T_t + \omega_0 S_s + \rho_0 T_t + \varepsilon
\end{aligned} \tag{8}$$

*Singlemother<sub>i</sub>* is a dummy variable equal to 1 if the individual is female, has at least one child, is older than 14, and lives separated or is divorced, widow, or single. In the data set, of all employed women, 22.44 percent are single mothers and for the results of table 11, men were deleted to have only a comparison between employed single mothers and other employed women.

### 6.5.1 Results for the Regressions for the Impact of the Crisis on Labor Income and Worked Hours of Single Mothers

The results for the triple interaction term in table 14 show that Mexican single mothers did not suffer more during the crisis than other women, which is against previous expectations. This confirms the results of Cunningham and Maloney (2000) that although single mothers are commonly considered as one of the most vulnerable groups during the period of an exogenous shock, they do not suffer more than other women in the Mexican case. One explanation could be the social networks in Mexico where although a woman is a single mother, she can rely on a large network of family members that lend support to each other.

## 7 Conclusion

The crisis of 2008 had a large negative impact on the labor income of the Mexican population living in the regions that are the most integrated to international trade. Individuals living in the northern states experienced the largest negative impact as these are the states that border with the United States and are highly dependent on international trade. Considering the employed population instead of the whole economically active population there was still a highly negative impact on labor income, which leads to the conclusion that labor income was not only reduced by dismissals during the crisis, but also by a reduction in the income of the employed population. The regional phenomenon follows the same pattern as for the whole economically active population: individuals in the northern states experienced a higher reduction in labor income and worked hours than individuals in the central and metropolitan region. Focusing on the sectors of manufacturing and commerce, which experienced the highest lay-off rates during the period of the crisis, against common expectations, individuals in the manufacturing sector did not suffer more than individuals in other sectors from an income reduction and employees in the commerce sector suffered even less than individuals in other sectors (non manufacturing and non commerce). Mexican women in the manufacturing sector, however, suffered more than women in other sectors from a reduction of their labor income, but in general, Mexican women did not experience a higher labor income reduction than men. What's more, the difference between labor income of men and women during the crisis was reduced significantly.

This study leaves many questions for future research. For example, there is room for a distinction of the impact among different educational levels and a distinction of the impact between the informal and formal labor market while considering differences between women and men. The average decrease of the difference between women's and men's labor income can have different origins, such as a proportionally higher layoff rate for men or an increase in women's labor income caused by a larger participation in higher paying jobs. Finding which of these two factors has a bigger contribution to overall impact would be an interesting and valuable contribution. Altogether, evidence shows that during the crisis of 2008 working

individuals in the Mexican states that have strong commercial ties with the United States suffered from a highly negative impact, but women in general experienced a reduction of the gap between their labor income and men's, while women in the manufacturing sector suffered more from an income reduction than women in other sectors.

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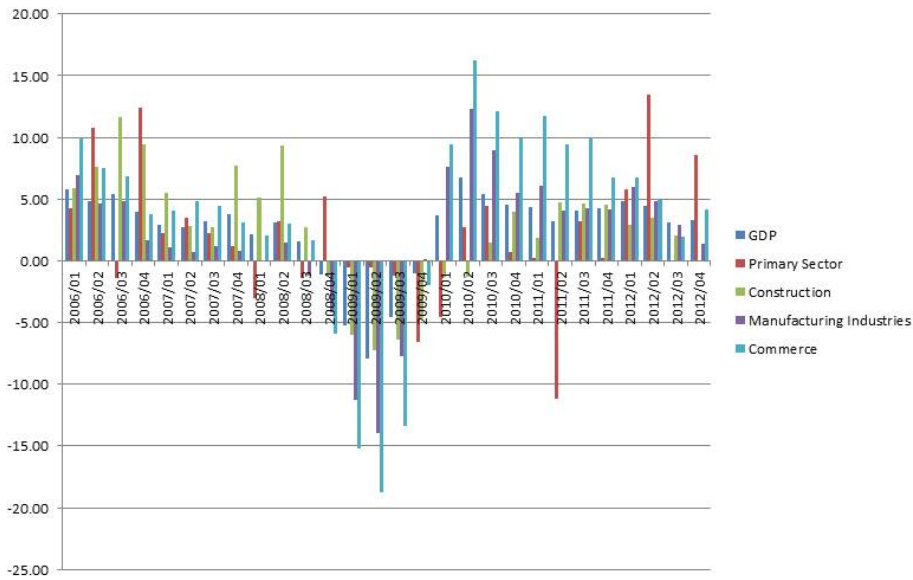
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# Appendix A: Figures

Figure 1: Annual percentage variation of the values for different sectors, 2008 prices, INEGI



Source: [www.inegi.org.mx/sistemas/bie/](http://www.inegi.org.mx/sistemas/bie/), Indicadores económicos de coyuntura > Producto interno bruto trimestral, base 2008 > Series originales > Variación anual de los valores a precios de 2008

Figure 2: Absolute Change in the Number of Employees in the different Sectors, ENOE

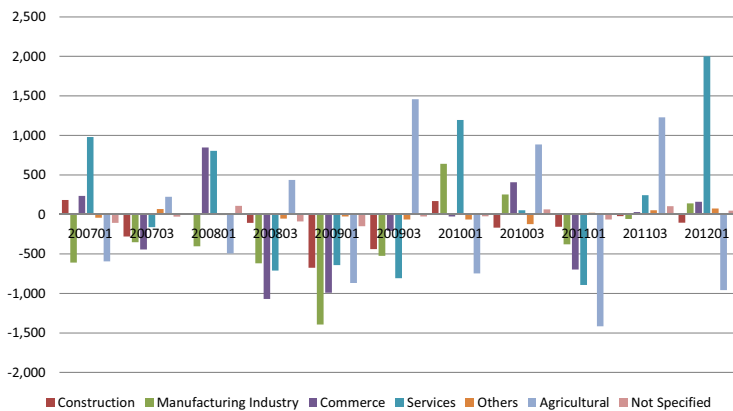


Figure 3: Employment of Women and Men in Treatment and Control Areas in Percentage

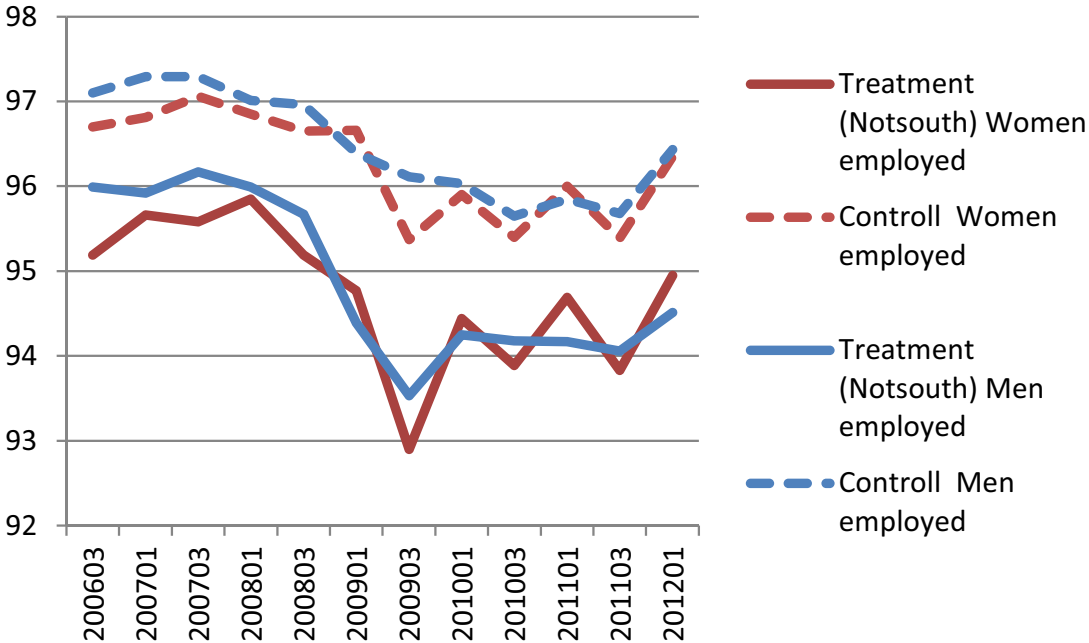


Figure 4: Unemployment of Women and Men in Treatment and Control Areas in Percentage

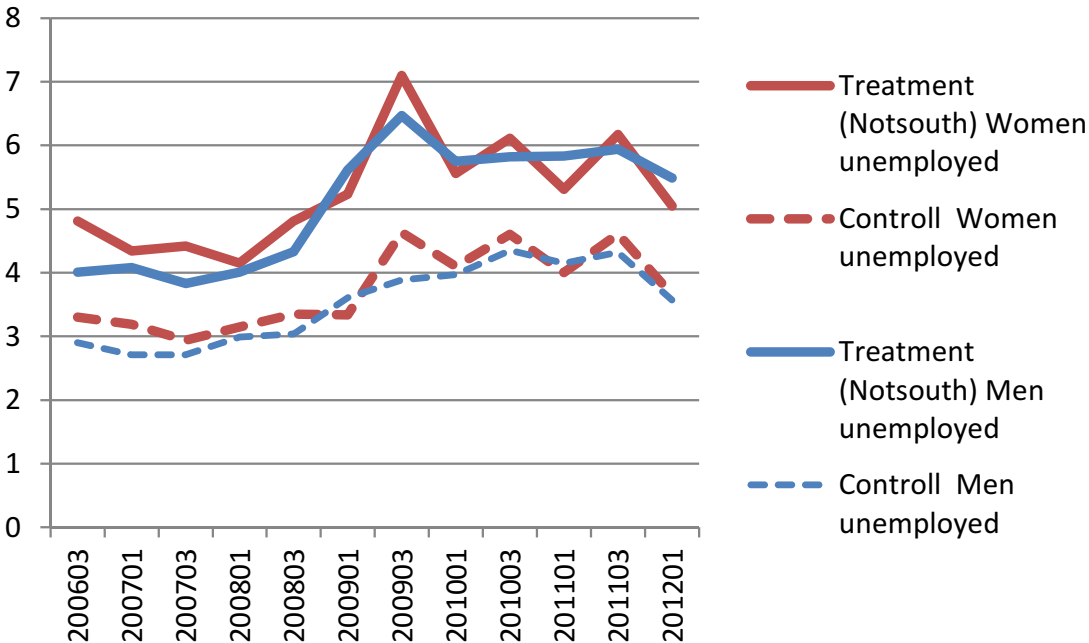


Figure 5: Employment of Women in the different Regions in Percentage

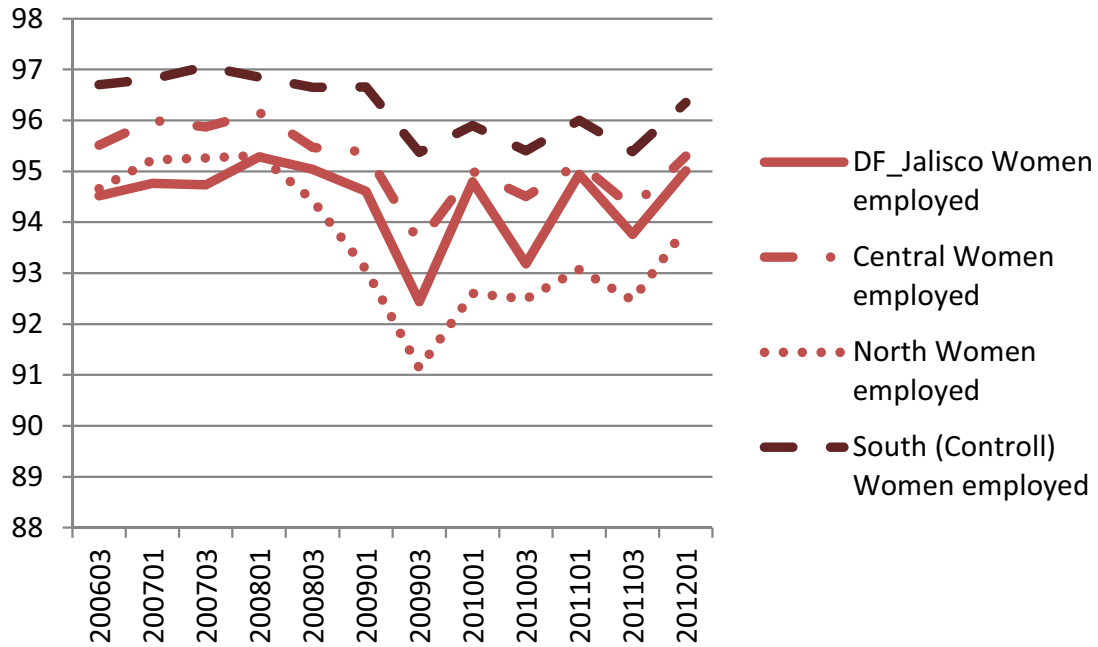


Figure 6: Unemployment of Women in the different Regions in Percentage

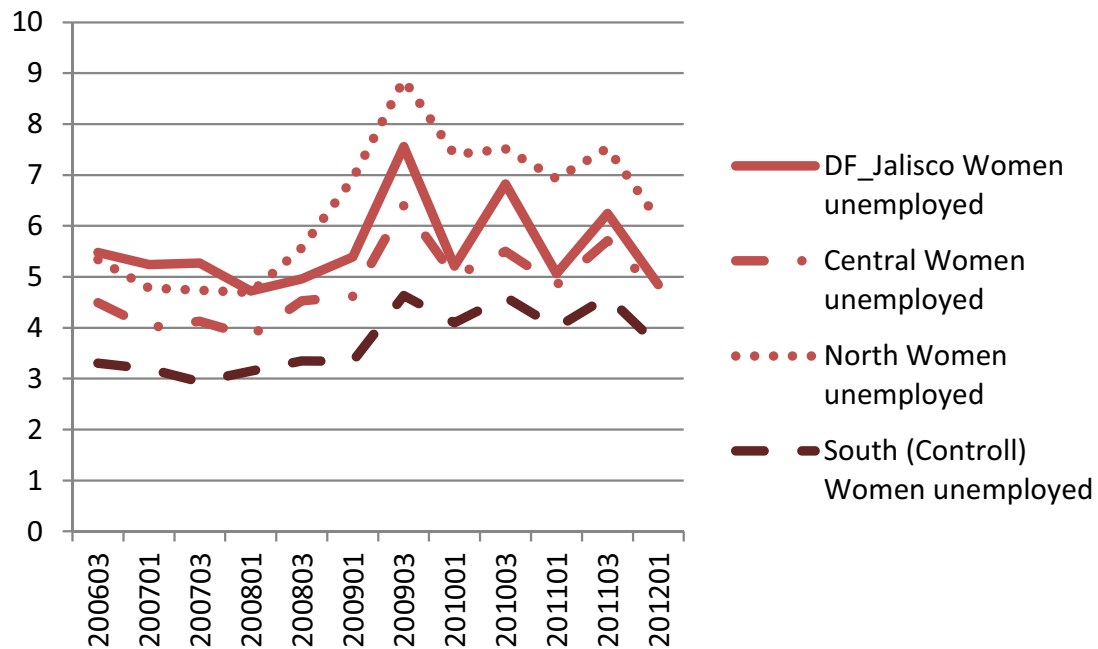


Figure 7: Employment of Men in the different Regions in Percentage

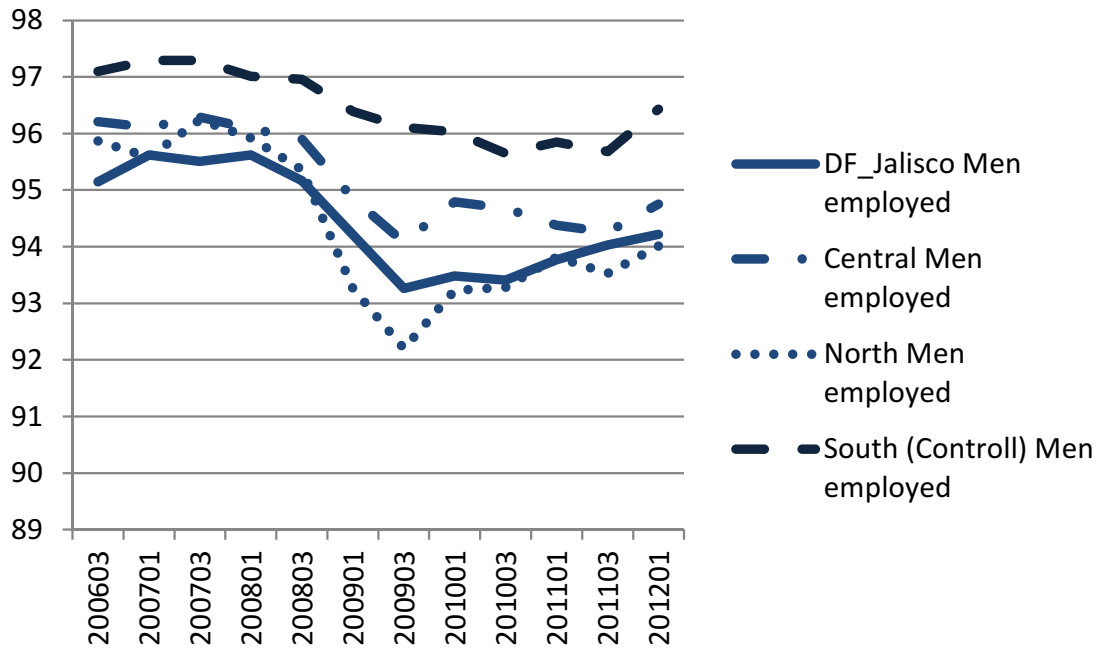
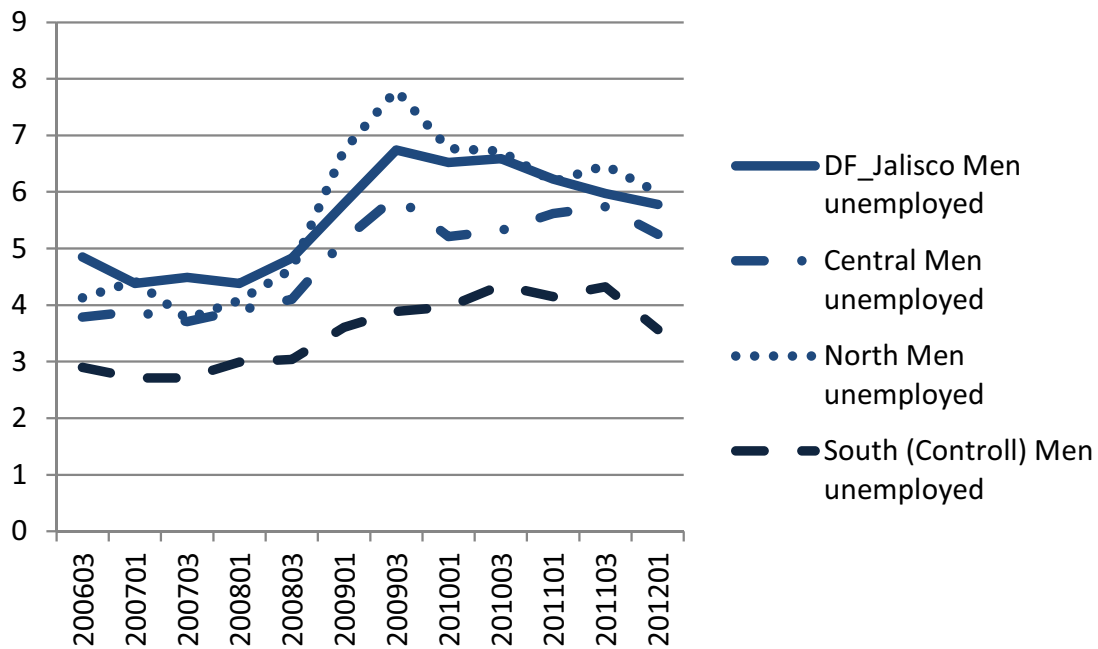


Figure 8: Unemployment of Men in the different Regions in Percentage



## Appendix B: Variables

Table 1: Variables

$T_t$	Vector of time fixed effects
$S_s$	Vector of state fixed effects
$crisis_t$	A dummy variable equal to 1 if the observation occurred during the first quarter of 2009 and the first quarter of 2010.
$central_s$	A dummy variable equal to 1 if the state $s$ is in the central region, based on export performance. States in the central region are Aguascalientes, Baja California del Sur, Colima, Durango, Guanajuato, Hidalgo, Michoacan, Morelos, Nayarit, Puebla, Queretaro, San Luis Potosi, Sinaloa, Tlaxcala, Veracruz, Yucatán, and Zacatecas. All are located in central Mexico, besides Yucatan. Collectively, central states accounted for 20 percentage of Mexico's accumulated exports between 1994 and 1999.
$DF/Jalisco_s$	A dummy variable equal to 1 if the states $s$ is the Federal District, Mexico State, or Jalisco. The Federal District (surrounded by Mexico State, where many Mexico City employees live) and Guadalajara, Jalisco are the two largest cities in Mexico.
$notsouth_s$	A dummy variable equal to 1 if the municipality is not in the southern (control) region, based on export performance. States in the control region are Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, and Tabasco. Combined, the control states produced less than 5 percentage of total national nonmaquila exports and less than 1 percentage of maquila exports, between 1994 and 1999.
$north_s$	A dummy variable equal to 1 if municipality $m$ is in the north region, based on exports. States in the north are Baja California, Coahuila, Chihuahua, Nuevo Leon, Sonora, and Tamaulipas.
$female_i$	A dummy variable equal to 1 if the individual is female.
$quarter_t$	Variable for the time of the observation. Every first and third quarter of a year, starting with the third quarter of 2006 and ending with the first of 2012.
$\ln Income$	The natural logarithm of the monthly income of an individual. It is corrected for inflation with the Mexican index of Consumer Prices del INEGI (Índice Nacional de Precios al Consumidor) with the 4. quarter of 2010 as base year.
$hours\ worked$	The hours worked of an individual of the passed week.
$manufacturing_i$	A dummy variable equal to one if the individual works in the manufacturing sector.
$commerce_i$	A dummy variable equal to one if the individual works in the commerce sector.
$singlemother_g$	A dummy variable equal to 1 if the individual is female, has at least one child, is older than 14, and lives separated or is divorced, widow, or single.

Table 2: Employed and Unemployed Men and Women in the different quarters

Quat.	Men	Women	Total	Employed			Unemployed			Manufacturing		Commerce	
				Men	Women	Total	Men	Women	Total	Men	Women	Men	Women
3.2006	105,464	67,163	172,627	101,455	64,120	165,575	4,009	3,043	7,052	16,831	10,085	16,327	16,744
1.2007	105,136	67,281	172,417	101,115	64,508	165,623	4,021	2,773	6,794	16,680	9,627	16,279	17,027
3.2007	104,026	67,170	171,196	100,258	64,392	164,650	3,768	2,778	6,546	16,321	9,634	16,031	16,832
1.2008	104,739	67,449	172,188	100,736	64,778	165,514	4,003	2,671	6,674	16,318	9,234	16,481	17,228
3.2008	103,767	66,807	170,574	99,530	63,775	163,305	4,237	3,032	7,269	15,750	9,184	15,932	16,708
1.2009	102,009	65,062	167,071	96,669	61,891	158,560	5,340	3,171	8,511	15,085	8,455	15,496	16,152
3.2009	101,705	66,736	168,441	95,626	62,322	157,948	6,079	4,414	10,493	14,446	8,570	15,058	16,382
1.2010	102,217	65,875	168,092	96,688	62,403	159,091	5,529	3,472	9,001	15,204	8,452	15,374	16,039
3.2010	103,286	66,779	170,065	97,569	62,893	160,462	5,717	3,886	9,603	15,063	8,846	15,505	16,314
1.2011	101,195	64,517	165,712	95,621	61,257	156,878	5,574	3,260	8,834	15,120	8,410	15,317	15,805
3.2011	102,013	66,069	168,082	96,267	62,189	158,456	5,746	3,880	9,626	14,874	8,599	15,204	15,948
1.2012	101,825	66,384	168,209	96,608	63,212	159,820	5,217	3,172	8,389	15,250	8,364	15,323	15,990
Total	1,237,382	797,292	2,034,674	1,178,142	757,740	1,935,882	59,240	39,552	98,792	186,942	107,460	188,327	197,169



## Appendix C: Tables

Table 3: Income and Worked Hours for the employed and unemployed population, collapse: quarter state

	ln Income		Worked Hours	
	(1)	(2)	(3)	(4)
notsouth_crisis	-0.149*** (0.025)		-0.809*** (0.113)	
DFJalisco_crisis		-0.145*** (0.03)		-0.743*** (0.072)
central_crisis		-0.121*** (0.032)		-0.618*** (0.124)
north_crisis		-0.230*** (0.054)		-1.383*** (0.212)
Quarter	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes
r2	0.559	0.562	0.248	0.262
N	736	736	736	736

Table 4: Income and Worked Hours for only the employed population, collapse: quarter state

	ln Income		Worked Hours	
	(1)	(2)	(3)	(4)
notsouth_crisis	-0.094*** (0.023)		-0.450*** (0.073)	
DFJalisco_crisis		-0.110*** (0.027)		-0.452*** (0.062)
central_crisis		-0.082** (0.032)		-0.352*** (0.091)
north_crisis		-0.118*** (0.039)		-0.727*** (0.125)
Quarter	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes
r2	0.505	0.506	0.063	0.068
N	736	736	736	736

Table 5: Income and Worked Hours, only employed, collapse: quarter, state, sector (manufacturing, commerce, and others)

	ln Income		Worked Hours	
	(1)	(2)	(3)	(4)
notsouth_crisis	-0.111*** (0.022)		-0.500*** (0.076)	
DFJalisco_crisis		-0.120*** (0.032)		-0.425*** (0.047)
central_crisis		-0.107*** (0.03)		-0.448*** (0.102)
north_crisis		-0.120*** (0.036)		-0.681*** (0.138)
Quarter	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes
r2	0.193	0.193	0.007	0.007
N	2208	2208	2208	2208

Table 6: Income and Worked Hours for only the employed population, collapse: quarter, state, sector (manufacturing, commerce, and others)

	(1)	(2)
	Dummy: notsouth	
	ln Income	Hours worked
notsouth_crisis_manufacturing	0.011 (0.046)	0.345 (0.302)
notsouth_crisis_commerce	0.075* (0.039)	0.741** (0.34)
notsouth_crisis	-0.154*** (0.028)	-0.886*** (0.089)
notsouth_commerce	-0.297* (0.159)	-0.408 (0.696)
notsouth_manufacturing	0.335** (0.139)	4.532*** (1.014)
commerce_crisis	-0.100*** (0.031)	-0.631** (0.308)
manufacturing_crisis	-0.108*** (0.039)	-0.841*** (0.277)
manufacturing	-0.018 (0.118)	-1.385 (0.949)
commerce	-0.148 (0.147)	4.604*** (0.645)
Quarter*State	Yes	Yes
r2	0.701	0.751
N	2208	2208

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table 7: Income and Worked Hours for the unemployed and employed population, collapse: quarter, state, sector (manufacturing, commerce, and others)

	(1)	(2)
	ln Income	Hours worked
DFJalisco_crisis_manufacturing	0.036 (0.063)	0.606* (0.323)
north_crisis_manufacturing	0.058 (0.061)	0.301 (0.399)
central_crisis_manufacturing	-0.011 (0.051)	0.314 (0.315)
DFJalisco_crisis_commerce	0.086 (0.062)	1.087*** (0.341)
north_crisis_commerce	0.079 (0.059)	1.035** (0.506)
central_crisis_commerce	0.071 (0.044)	0.576 (0.342)
DFJalisco_crisis	-0.211*** (0.035)	-1.141*** (0.115)
central_crisis	-0.148*** (0.039)	-0.776*** (0.106)
north_crisis	-0.145*** (0.04)	-1.072*** (0.177)
central_commerce	-0.344** (0.161)	-0.047 (0.717)
north_commerce	-0.123 (0.21)	-0.949 (0.835)
DFJalisco_commerce	-0.373* (0.187)	-1.375** (0.665)
central_manufacturing	0.238 (0.144)	4.235*** (1.052)
north_manufacturing	0.651*** (0.176)	5.402*** (1.202)
DFJalisco_manufacturing	0.252 (0.167)	4.477*** (1.017)
commerce_crisis	-0.100*** (0.031)	-0.631** (0.309)
manufacturing_crisis	-0.108*** (0.039)	-0.841*** (0.278)
manufacturing	-0.018 (0.119)	-1.385 (0.951)
commerce	-0.148 (0.147)	4.604*** (0.647)
Quarter*State	Yes	Yes
r2	0.723	0.771

N

2208

2208

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\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 8: Female and male distinction for the employed and unemployed population, collapse: state, quarter, female

	(1)	(2)	(3)	(4)
	Dummy: notsouth		Regional dummies: central, north	
	ln Income	Hours worked	ln Income	Hours worked
notsouth_crisis_female	0.147*** (0.036)	0.930*** (0.247)		
notsouth_crisis	-0.272*** (0.039)	-1.483*** (0.14)		
notsouth_female	-0.127 (0.103)	0.732 (0.517)		
crisis_female	-0.094*** (0.033)	-0.551** (0.231)	-0.094*** (0.033)	-0.551** (0.232)
female	-0.274*** (0.094)	-8.448*** (0.419)	-0.274*** (0.094)	-8.448*** (0.42)
DFJalisco_crisis_female			0.146*** (0.038)	0.728** (0.265)
DFJalisco_crisis			-0.297*** (0.038)	-1.499*** (0.138)
DFJalisco_female			-0.056 (0.1)	0.936 (0.607)
central_crisis_female			0.141*** (0.039)	1.009*** (0.255)
central_crisis			-0.252*** (0.039)	-1.361*** (0.174)
central_female			-0.151 (0.107)	0.417 (0.527)
north_crisis_female			0.165*** (0.042)	0.806** (0.298)
north_crisis			-0.319*** (0.071)	-1.833*** (0.296)
north_female			-0.095 (0.148)	1.523 (0.912)
Quarter*State	Yes	Yes	Yes	Yes
r2	0.793	0.952	0.795	0.954
N	1472	1472	1472	1472

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

Table 9: Female and male distinction for only the employed population, collapse: state quarter female

	(1)	(2)	(3)	(4)
	Dummy: notsouth		Regional dummies: central, north	
	ln Income	Hours worked	ln Income	Hours worked
notsouth_crisis_female	0.122*** (0.031)	0.746*** (0.232)		
notsouth_crisis	-0.219*** (0.029)	-1.109*** (0.1)		
notsouth_female	-0.14 (0.099)	0.618 (0.527)		
crisis_female	-0.085*** (0.028)	-0.522** (0.216)	-0.085*** (0.028)	-0.522** (0.217)
female	-0.268*** (0.091)	-8.664*** (0.439)	-0.268*** (0.091)	-8.664*** (0.44)
DFJalisco_crisis_female			0.109*** (0.029)	0.429* (0.24)
DFJalisco_crisis			-0.261*** (0.027)	-1.139*** (0.118)
DFJalisco_female			-0.076 (0.102)	0.734 (0.67)
central_crisis_female			0.117*** (0.034)	0.854*** (0.239)
central_crisis			-0.213*** (0.04)	-1.078*** (0.128)
central_female			-0.175* (0.102)	0.246 (0.53)
north_crisis_female			0.142*** (0.045)	0.598** (0.276)
north_crisis			-0.216*** (0.054)	-1.189*** (0.226)
north_female			-0.075 (0.134)	1.614* (0.847)
Quarter*State	Yes	Yes	Yes	Yes
r2	0.788	0.96	0.792	0.963
N	1472	1472	1472	1472

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

Table 10: Female and male distinction with sector interaction for the employed population, collapse: quarter, state, female, sector (manufacturing, commerce, others)

	(1)	(2)
	ln Income	Hours worked
notsouth_crisis_female_commerce	-0.004 (0.048)	0.397 (0.33)
notsouth_crisis_female_manufacturing	-0.215*** (0.063)	-0.699 (0.519)
notsouth_crisis_female	0.119** (0.044)	0.784*** (0.158)
notsouth_female_commerce	0.315*** (0.09)	0.505 (0.835)
notsouth_crisis_commerce	0.043 (0.054)	0.259 (0.272)
crisis_female_commerce	0.035 (0.036)	-0.177 (0.269)
notsouth_female_manufacturing	0.895*** (0.124)	7.674*** (1.072)
notsouth_crisis_manufacturing	0.085** (0.04)	0.542** (0.224)
crisis_female_manufacturing	0.162*** (0.047)	0.483 (0.461)
notsouth_crisis	-0.172*** (0.027)	-0.961*** (0.096)
crisis_female	-0.082* (0.041)	-0.577*** (0.121)
notsouth_female	-0.224** (0.092)	-0.015 (0.426)
commerce_crisis	-0.086* (0.047)	-0.266 (0.212)
commerce_female	-0.861*** (0.073)	-0.55 (0.777)
notsouth_commerce	-0.454*** (0.158)	-1.176* (0.578)
manufacturing_crisis	-0.165*** (0.032)	-0.982*** (0.196)
manufacturing_female	-1.288*** (0.093)	-6.191*** (0.741)
notsouth_manufacturing	-0.092 (0.161)	0.384 (0.731)
female	0.031 (0.084)	-8.817*** (0.3279)
commerce	0.312** (0.144)	6.618*** (0.5)
manufacturing	0.555*** (0.147)	2.230*** (0.687)
Quarter*State	Yes	Yes
r2	0.693	0.892
N	54416	4416

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01





Table 11: Impact on single mothers for employed women only, collapse: state, quarter, singlemother

	(1)	(2)	(3)	(4)
	Dummy: notsouth		Regional dummies: DF_Jalisco, central, north	
	ln Income	Hours worked	ln Income	Hours worked
notsouth_crisis_singlemother	0.079*	0.128		
	(0.043)	(0.208)		
notsouth_crisis	-0.203***	-0.839***		
	(0.025)	(0.112)		
notsouth_singlemother	-0.061	0.25		
	(0.077)	(0.418)		
crisis_singlemother	-0.057	-0.412***	-0.057	-0.412***
	(0.036)	(0.108)	(0.037)	(0.108)
singlemother	0.682***	2.600***	0.682***	2.600***
	(0.063)	(0.373)	(0.063)	(0.374)
DFJalisco_crisis_singlemother			0.008	-0.135
			(0.112)	(0.22)
DFJalisco_crisis			-0.253***	-1.136***
			(0.05)	(0.039)
DFJalisco_singlemother			-0.119*	0.172
			(0.069)	(0.505)
central_crisis_singlemother			0.090**	0.11
			(0.042)	(0.256)
central_crisis			-0.206***	-0.708***
			(0.031)	(0.136)
central_singlemother			0.013	0.492
			(0.084)	(0.435)
north_crisis_singlemother			0.082	0.31
			(0.058)	(0.49)
north_crisis			-0.169***	-1.072***
			(0.0499)	(0.2259)
north_singlemother			-0.244***	-0.398
			(0.069)	(0.499)
Quarter*State	Yes	Yes	Yes	Yes
r2	0.829	0.764	0.843	0.773
N	1472	1472	1472	1472

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01