

# **Natural Disasters and the Family in Areas with High Levels of Insurance**

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# Natural Disasters and the Family in Areas with High Levels of Insurance

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**Abstract:** A natural disaster can greatly reduce human capital accumulation by households, and decrease the possibility of social mobility. Many of the actual studies of natural disasters are based on areas with low levels of insurance and high rates of poverty. In this study, I analyze the effect of the hurricane Odile in Mexico on income, consumption and education outcomes in an area with a relative high level of insurance on the principal economic activity and low rates of poverty. To analyze the effects of the hurricane on the incomes of interest, I use a difference-in-difference (DID) estimation approach. I do not find evidence of the effects of the hurricane Odile on income, school attendance, or expenditures of food. However, I find evidence that the hurricane affected some prices, and a decrease in the consumption of goods such as chicken, milk, and eggs. This reduction is observed when the head of the household is a man, but not when the head of the household is a woman.

*JEL Classification:* I14, I24, Q54.

# 1 Introduction

During the period 2011-2013 the world experienced three consecutive years of economic losses that exceeded 100 billion dollars per year due to natural disasters (INEGI, 2013). Unfortunately, Mexico is among the 30 countries that is most exposed to two types of natural disasters: hurricanes and earthquakes. The population that is most vulnerable to natural disasters represents around 27% of the country (INEGI, 2013).

A natural disaster can greatly reduce human capital accumulation by households, and as a consequence decreases the possibility of social mobility. The first effect is concerning income; with the potential to affect education and consumption. While the economic theory predicts that individuals maintain the levels of consumption against income shocks, there is evidence that this is not always the case (Kazianga and Udry, 2006). On the other hand, other studies have found that natural disasters affects the school attendance, and the money intended for school (Jensen 2000, Cameron and Worswick 2001). A particular consensus in these studies is that the families affected the most have lack of insurance (formal or informal), and they are relatively poor.

In this study, I analyze the effects of a hurricane on income, consumption, and education outcomes in an area with a relatively high level of insurance on the principal business activity, and with high Human Development Index. I use the Survey of Social Mobility in Disaster Zones in Mexico. The “treatment” location was the municipality of La Paz, in the state of Baja California Sur. This area was affected by the hurricane Odile in 2014. As a “control” group, I use the municipality of Ahome in the state of Sinaloa, and was not affected by the hurricane Odile. Both localities have a

relatively high index of Human Development: La Paz (.89) and Ahome (.87). The principal activity in Baja California Sur is the tourism. Most of the hotels are part of strong brands with the ability to have protection from insurance. Another important sector is the agricultural; however, in general, this sector is not protected by insurance. But, at the time of the occurrence of the hurricane Odile it received help from the government.

To analyze the effects of the hurricane regarding the outcomes of interest, I use a difference-in-difference (DID) estimation approach. I do not find effects of the hurricane concerning the income of the employed members of the household. And, as a consequence, I do not find evidence of the effects of the hurricane on school attendance or food expenditures. These effects can be explained in part because the firms participating in the principal economic activity (tourism) were protected with insurance during the natural disaster. However, the agricultural sector was not completely protected, and I find evidence that the hurricane affected some prices. Given the fact that the families did not change their food expenditures, I observed a reduction in the consumption of chicken, milk, and eggs. However, this reduction was observed primarily in households when the head was a man, but not when it was a woman.

The rest of the paper is organized as follows. In Section 2, I present the background. In Section 3 and 4, the data, empirical strategy and results are presented. I conclude with Section 5.

## 2 Background

### 2.1 Previous findings

Relating to income, using data for earthquakes that affected El Salvador in 2001, Baez and Santos (2008) find a reduction of one third of the income per capita. This reduction in income can have consequences in terms of consumption and education, and particularly can affect the accumulation of human capital for the children living in the households that were affected.

The economic theory predicts that individuals smooth the levels of consumption against income risk; however, there is evidence that this is not always the case. Kazianga and Udry (2006), using the effect of drought in rural Burkina Faso, find evidence of little consumption smoothing. While this shows that the households cannot handle the shock with their available resources (like possession of durable goods or access to credit), it also opens the possibility that there is not a market of insurance that can help these families to face adverse situations.

Concerning the case of the effects of a shock on the school attendance, it should be expected that once the natural disaster affects the infrastructure of the community, the demand for male labor will increase, as men are predominately in these occupations. This opens the possibility that boys could drop out of the school with more probability than girls. But also, the hurricane can affect the income of the household, and as a consequence, it can decrease the demand for education, affecting both boys and girls. Jensen (2000), using data from Cote d'Ivoire find that school attendance for boys fell more than for girls in response to the drought. However, Cameron and Worswick (2001), using data from a crop failure in Indonesia, find that school enrollment for girls fell more than that of boys.

Many of these results come from areas where most of the families were relatively poor, and had lack of insurance. This is not the case for the area analyzed in this paper. As, I will show in the next subsection, many of the firms that determine the economic activity in the area have insurance, and as a consequence, these help to mitigate the effect of the hurricane.

## 2.2 Hurricane Odile in Baja California Sur

The state of Baja California Sur is in the southern of the Baja California Peninsula in Mexico. The state is divided into five municipalities: Comondú, Mulegé, Loreto, Los Cabos and La Paz. The present study was developed in the municipality of La Paz. The population in La Paz was 251,871 in 2010, and the majority of the population lived in the city of La Paz (215,178). During the year of 2014, the inflation rate was 4.65%, compared with 4.08% at the national level. In relation to unemployment, the rate of unemployment in the second quarter of 2014 was 4.9% in BCS (similar to the national level); and it was 6.0% in the fourth quarter of 2014 vs. 4.4% at the national level. However, in the third quarter of 2015, the unemployment rate has been reduced to 5.0%, that is close to the national level of 4.6 %.

Hurricane Odile affected BCS during September 10th to September 19th of 2014, reaching a category 4 intensity on September 14th, and being among the top 10 most intense Pacific Hurricanes from 1949-2014 (National Hurricane Center, 2015). Since 2010, BCS had not been affected by hurricanes <sup>1</sup>. Initially only minor alerts were posted by the local governments; however, Odile unexpectedly took a direct course towards the peninsula.

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<sup>1</sup>Being hurricane Jimena the last registered, but not in the intense of Odile

The consequences of the hurricane on the infrastructure were significant. According to the Presidency of the Republic, 95% of users of energy ran out the service by damage of the electrical transmission towers, 100% of the drinking water supply was interrupted, and the hotel infrastructure suffered severe damage. It should be notice that one of the most important economic activities of the area is tourism. At the time of the landfall, hotels were at 46% occupancy, equal to 30,000 tourists; 26,000 of which were foreigners. More than 10,000 houses were affected, but there were only 1,800 with total damage. The damages associated with Odile were estimated in MXN\$ 16.6 billion (US\$1.22 billion). The number of people that died as a consequence of the hurricane was 6. A group of experts for the Engineering Institute of the National University Autonomous of Mexico did an inspection during September 25th and October 5th in the cities of La Paz, San Jose del Cabo and Cabo San Lucas. They confirmed the damage originally reported, but also they found that the area was “recovering quickly from the damage caused by the hurricane”.

The quick recovery could be explained as a consequence that the majority of the hotels were protected by insurance. According to the Hotels Association, the “advances of cash allowed many hotels to start the reconstruction within a few weeks of the hurricane”. On July 1st of 2015, the association reported that 80 % of the hotels supply was operating normally, and the other 20% missing was not only under construction to repair the damage, but also “creating new products with innovative concepts to attract travelers”. Furthermore, an additional three thousands rooms will be added by luxury hotels brands.

However, not all the sectors were insured. In the case of agriculture, Odile affected 200 hectares of protected agriculture “greenhouse” and 5,000 hectares of traditional agriculture. The Minister of Agriculture announced a support until 70,000 pesos per hectares in the “greenhouse” areas and

2,000 pesos per hectare in areas with traditional agriculture. This situation will be fundamental for the analysis. The insurance of the tourism sector helped to mitigate the effects of the hurricane on household incomes; however, the lack of insurance in the agriculture sector had the consequence to transmit the effect of prices on household consumption.

### 3 Data

I will analyze the effects of hurricanes on income, consumption, and education. To analyze these effects, I will use a unique database, the Survey of Social Mobility in Disaster Zones. In particular, I will use the quasi-experimental section of this survey.

The quasi-experimental part selected locations that were not affected by a hurricane or other natural disasters in the last four years, but were affected in 2014. The only locations that satisfy this condition were the localities affected by the hurricane Odile in Baja California Sur. Another condition was that the localities selected had a “similar” location, being that they were not affected directly by the hurricane, but close in proximity to the hurricane area. The municipality of La Paz in BCS was chosen as a “treatment”, and as a “control” group the municipality of Ahome in Sinaloa. The municipality of La Paz has a Human Development Index of .89, while that of Ahome is .87, both being classified as a high index. After selecting the municipalities, 250 households were selected by random in the municipality of La Paz, and 250 in the municipality of Ahome <sup>2</sup>.

As it was mentioned before, these households are not relatively poor. For example, previous to the shock, 97% had refrigerator, 58% had computers, 56% had access to internet and 68% had

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<sup>2</sup>At the end it was collected information of 295 households in La Paz and 279 households in Ahome



an automobile in the treatment and control group (see Table 1). However, even though they look similar, there are some statistically differences. For example, while 87% of the houses in Ahome had washing machines, only 81% had washing machines in La Paz (see Table 1). In terms of the number of members of the household, in La Paz it was 3.67, while in Ahome it was 3.84. However, there was not statistically difference in the number of children below 15 years of age (almost 1 child). While there are some statistically significant differences in some variables, in general, households in Ahome are similar to the households in La Paz and, as a result, constitute a good control group for the study on the basis of relevant observable characteristics.

## 4 Empirical Strategy and Findings

### 4.1 Identification

The objective of this paper is to examine whether the hurricane affected the levels of income, consumption, and education. Ideally, I would like to calculate the effects of the hurricane on each of these measures by comparing the actual outcome with the outcome in the absence of the shock. Because this is impossible, I rely on the construction of a proper counterfactual to get the impact of the hurricane. Since Odile trajectory was exogenous, households spared by the storm constitute a natural control group. Hence, the approach is to compare the changes in the outcome of interest between August 2014 and June 2015 among the region directly hit by Odile (La Paz) and those that occurred in the control area (Ahome).

I applied the difference-in-difference (DID) estimation approach to examine the effect of the shock caused by Odile. I estimate the following equation:

$$Y = \beta_0 + \beta_1 Year + \beta_2 D + \beta_3 (Year * D) + X_i \theta_i + e_{it}$$

Where Y is the variable of interest; Year is a dummy variable with Year=1 (after-shock) and Year=0 (pre-shock); D is a dummy variable that assumes the value of 1 if the municipality is affected by the hurricane and 0 otherwise; and Z is a group of controls. Note that, in the equation specification, the coefficient  $\beta_3$ , is the DID estimator.

## 4.2 Results

### 4.2.1 Income

Table 2 presents the estimated functions that explain income. The year dummy, which shows overall trends in 2015 compared to 2014 (the base year), was positive, but not statistically significant, indicating an increase of overall income over time (1,547 pesos). On average, income of households in the hurricane-affected area were lower than households in the unaffected districts (690 pesos). However, the interaction term, the dummy variable indicating hurricane-affected areas multiplied by the year, was negative, but not statistically significant in the estimated function.

While it is true that the principal activity of the area is tourism, and many of the hotels were protected by insurance, it is possible that the hurricane affected differently for the men and women. In column (2) and (3), the results for men and women are presented respectively. The interaction term for the men is positive and that of women is negative; however, both of them are not statistically significant. In order to have a more pure effect, in column (4) I analyze only the salary of the head of the household, and in columns (5) and (6), when the head of the household is a man and

a woman, respectively. Analyzing the head of the households (column 4), the interaction term is negative, in the case of the man (column 5) this is positive; and in the case of the woman (column 6) this is negative. However, the coefficients are not statistically significant. Results reveal that hurricane Odile do not reduced the income of the households in the affected area compared with households in the non-affected area.

#### **4.2.2 Education**

In Table 3 column (1), I present the results about school attendance. The year dummy is negative and statistically significant, indicating an overall decrease over time in the school attendance. However, the interaction term, the dummy variable indicating hurricane-affected area multiplied by the year, was negative, but not statistically significant. In order to verify that it was not just an effect of pooling the data, I analyze the effects of the hurricane making a difference between boys and girls. The signs of the results are consistent with other findings in the literature, i.e. a decrease in the attendance for the boys and an increase in the attendance of the girls; however, the results are not statistically significant.

The previous results make sense if we take into account that there was not an effect on the income, and as a consequence, it did not change the opportunity cost to attend the school. Another concern is the possibility that children continue attending the school, but it could be the case that the parents reduce the money in order to attend the school. I analyze this situation in columns (4) to (6). In column (4), I show that there is no evidence of reduction in the daily expenses to attend the school. Furthermore, when I analyze the results for boys (column 5) and for girls (column 6), there is a decrease in the money given to boys, and an increase in the money given to girls, but

the effects are not statistically significant. The results confirm that the hurricane did not have any effect on the school attendance, nor for daily expenses.

### 4.2.3 Consumption

The next question is to understand the effects of the hurricane on food consumption. The economic hypothesis of the permanent income establishes that the individuals will try to smooth their consumption. As a consequence we should not expect any effect of the hurricane on the consumption. In order to test this hypothesis, I analyze the effect of the hurricane on food expenditure in Table 4. To simplify, I only present the interaction term, i.e. the effect of the hurricane. I observe an increase on the expenditure for food (an increase of 81 pesos), but this is not statistically significant. When I analyze the expenditure of the household taking into account who is the head of the household, I observe an increase in the household where the head of the household is a man (45 pesos), and a decrease in the households when the head is a woman (29 pesos). However, both effects are not statistically significant. And, as a consequence, the result confirms that there is not an effect on the expenditure for food.

While the principal economic activity was relatively well protected by insurance for the tourism industry, the agricultural sector was not completely protected. As a consequence, it opens the possibility that the hurricane could have some effects on the level of prices, and as a consequence, it can generate a redistribution of the consumption inside the household. In order to analyze this mechanism, I analyze the effects of the hurricane on quantities consumed and prices of the following goods: corn, beans, lemons, bananas, sugar, chicken, fish, eggs, and milk.

An increase of the price of lemons, sugar, and eggs is observed due to the hurricane, see Table 5. Given that the families did not change the money intended to buy food, a redistribution on the quantities demanded inside the household should be expected. In column (1) of Table 5, it is observed a decrease in the consumption of eggs, chicken, and milk. Then I analyze these results considering if the head of the household is a man or a woman, the results are presented in Table 5, column (2) and (3). The quantities demanded for chicken, eggs, and milk decreased in the household when the man was the head of the household; however, it did not happen for the households when the head was a woman.

To sum up, the affected area was relatively well protected against shocks, as a consequence and in line with the economic theory, it is not observed an effect on the income of the families. In addition, if the salary is not affected, then it does not affect the opportunity cost, and as a consequence, there is no effect on the school attendance. However, the agriculture sector was not protected by insurance, and while the Mexican government supported partially the sector, an increase in some prices were observed. Given that the income of the households were not affected, it appears that it did not affect the money that the households intended for food expenditures. However, the increase in some prices, forced the households to decrease the consumption of some goods; particularly eggs, milk, and chicken. An interesting result is that the decrease in the quantities consumed is observed in houses when the head of the household is a man, but not when the head is a woman. Although we can assume that there was a redistribution of food resources inside the household, we can not determine which specific members were affected. However, there can be consequences on the human capital if the affected members were children.

## 5 Conclusion

A natural disaster can greatly reduce human capital accumulation by households, and decrease the possibility of social mobility. Many of the actual studies of natural disasters are based on areas with low levels of insurance and high rates of poverty. In this study, I analyze the effect of the hurricane Odile in Mexico on income, consumption and education outcomes in an area with a relative high level of insurance on the principal business activity, and with high Human Development Index. To analyze the effects of the hurricane on the incomes of interest, I use a difference-in-difference (DID) estimation approach. I do not find evidence of the effects of the hurricane Odile on income, school attendance or expenditure in food. However, I find evidence that the hurricane affected some prices, and the consumption of goods as chicken, milk and eggs. However, this reduction in consumption is observed in households when the head of the household is a man, but not when the head of the household is a woman.

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Table 1: Descriptive statistics

	Total	La Paz	Ahome	Diff.
No of members	3.67 (0.07)	3.84 (0.10)	3.50 (0.09)	0.33** (0.14)
No of children (0-15 years)	0.86 (0.04)	0.91 (0.06)	0.81 (0.06)	0.09 (0.09)
Age of HH	48.07 (0.57)	47.29 (0.75)	48.87 (0.86)	-1.57 (1.14)
Proportion of houses head by men	0.69 (0.02)	0.70 (0.02)	0.69 (0.02)	0.01 (0.03)
Computer	0.58 (0.02)	0.57 (0.02)	0.58 (0.02)	-0.07 (0.04)
Gas stove	0.98 (0.005)	0.97 (0.008)	0.98 (0.06)	-0.09 (0.01)
Wash machine	0.84 (0.01)	0.81 (0.02)	0.87 (0.01)	-0.06 ** (0.03)
Refrigerator	0.97 (0.006)	0.97 (0.008)	0.97 (0.008)	-0.001 (0.012)
DVD	0.67 (0.02)	0.69 (0.03)	0.65 (0.03)	0.03 (0.04)
Television	0.67 (0.02)	0.69 (0.03)	0.65 (0.03)	0.03 (0.04)
Water heater	0.51 (0.02)	0.46 (0.02)	0.57 (0.03)	-0.10 ** (0.04)
Cell phone	0.83 (0.02)	0.84 (0.02)	0.80 (0.02)	0.04 (0.03)
Microwave	0.61 (0.02)	0.58 (0.03)	0.64 (0.03)	-0.06 (0.04)
Toaster	0.40 (0.02)	0.39 (0.03)	0.40 (0.03)	-0.01 (0.04)
Internet	0.56 (0.02)	0.54 (0.03)	0.58 (0.03)	-0.04 (0.04)
Piped water	0.95 (0.01)	0.92 (0.02)	0.98 (0.01)	-0.06** (0.02)
Bath inside the house	0.95 (0.01)	0.94 (0.01)	0.97 (0.01)	-0.02 (0.02)
Electricity	0.96 (0.01)	0.94 (0.01)	0.99 (0.01)	-0.04 *** (0.01)
Landline	0.54 (0.02)	0.51 (0.03)	0.57 (0.03)	-0.06 (0.04)
Cable TV	0.65 (0.02)	0.65 (0.03)	0.67 (0.03)	-0.02 (0.04)
Automobile	0.68 (0.02)	0.70 (0.03)	0.66 (0.03)	-0.04 (0.04)
N	574	295	279	

*Standard errors in parentheses.*

\*\*\* p < 0.01, \*\* p < 0.05, \*p < 0.1



Table 2: Difference-in-Difference Estimates of the Impact of the Shock on Income

	Total	Man	Woman	HH (both)	HH (Man)	HH (Woman)
Year	1,547.66 (1,159.08)	56.12 (769.83)	4,574 (3,339.31)	3,262.08 (2,010.28)	410.60 (869.42)	18,859 (13,651.95)
Affected municipality	-690.40 (1,161.51)	-512.13 (748.49)	-1,580.82 (3,562.71)	-44.61 (2,002.36)	330.78 (861.28)	-2,264.33 (12,984.98)
Year x	-1,138.27	491.22	-4,561.75	-2,540.63	403.08	-18,755.67
Affected municipality	(1,631.73)	(1,049.00)	(5,154.95)	(2,808.63)	(1,214.40)	(19,006.5)
N	501	358	143	269	232	37

*Standard errors in parentheses.*

\*\*\* p < 0.01, \*\* p < 0.05, \*p < 0.1

Table 3: Difference-in-Difference Estimates of the Impact of the Shock on School Attendance and Daily Expenses

	School Attendance			Daily Expenses		
	Total	Man	Woman	Total	Man	Woman
Year	-0.09*** (0.02)	-0.09** (0.03)	-0.09** (0.03)	-18.37* (7.21)	-6.20 (7.61)	-40.33* (16.27)
Affected municipality	0.00 (0.02)	-0.00 (0.03)	-0.00 (0.03)	-11.97 (6.84)	10.43 (7.26)	-42.39** (15.26)
Year x	-0.01	-0.04	0.01	7.61	-7.78	30.70
Affected municipality	(0.03)	(0.04)	(0.04)	(9.93)	(10.62)	(22.02)
N	1105	458	418	929	401	348

*Standard errors in parentheses.*

\*\*\* p < 0.01, \*\* p < 0.05, \*p < 0.1

Table 4: **Difference-in-Difference Estimates of the Impact of the Shock on Food Consumption**

	Total	Man	Woman
Food expenditure	81.73 (298.48)	45.87 (565.24)	-29.42 (766.42)

*Standard errors in parentheses.*

\*\*\* p < 0.01, \*\* p < 0.05, \*p < 0.1

Table 5: **Difference-in-Difference Estimates of the Impact of the Shock on Food Consumption**

	Quantity			Price
	Total	Men	Women	
Corn	0.95 (3.45)	-0.40 (4.17)	5.59 (6.64)	-0.00 (0.46)
Bean	0.40 (2.13)	0.60 (2.65)	0.31 (2.25)	-0.65 (2.07)
Lemon	0.33 (1.29)	0.66 (1.60)	-0.68 (1.89)	9.17* (4.54)
Banana	0.19 (1.14)	-0.26 (1.45)	0.55 (2.00)	1.18 (1.19)
Sugar	-2.58 (2.05)	-3.52 (2.77)	-0.36 (1.34)	3.43* (1.38)
Chicken	-2.92** (0.92)	-3.46** (1.04)	-1.17 (1.85)	-1.75 (5.43)
Fish	-1.78 (1.18)	-2.33 (1.55)	0.26 (1.41)	0.98 (6.33)
Eggs	-4.05* (2.43)	-5.43* (2.86)	-0.09 (4.94)	11.92* (4.77)
Milk	-5.94* (2.76)	-7.22* (3.19)	3.40 (6.08)	0.14 (1.69)

*Standard errors in parentheses.*

\*\*\* p < 0.01, \*\* p < 0.05, \*p < 0.1