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Socioeconomic consequences of natural disasters on gender relations: The case of Haiti

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ABSTRACT

This paper aims to analyze how the consequences of natural disasters affect gender relations in socioeconomic terms. To meet this objective, we quantitatively analyzed the effect of the earthquake that occurred in Haiti in 2010 based on data from the Demographic and Health Survey (DHS) developed by the United States Agency for International Development (USAID).

To measure the impact of the 2010 earthquake we used the differences in differences (DID) technique. The estimation shows how the negative effects of the disaster differed across regions, increasing with the intensity of the earthquake's impact, and that this was significantly statistically related to the wealth of families, regardless of the gender of the head of the family. However, we also observed that these negative effects were further intensified when the head of the household was a woman, thus increasing the gap between the wealth of female- and male-headed households.

The conclusions drawn from this work reinforce the idea that natural disasters have a more negative impact on women and, specifically, on the economic possibilities of female-headed households, and show that, at least in Haiti, the enormous gender inequalities that existed prior to the earthquake do not diminish postdisaster, but are indeed exaggerated. These findings have important political implications that should not be ignored.

1. Introduction

Until fairly recently, academic works looking at the impact of natural disasters (such as earthquakes, tsunamis, floods, etc.) on gender relations were not common, principally due to the lack of gender-specific data available. However, the emergence of data disaggregated by sex has greatly facilitated the investigation of this phenomenon and, since the 90s, a number of studies have shown that disasters do not affect the entire population involved in the same way, and that the most vulnerable sectors, among them women, are those most affected [3,4,9,14].

Data suggest that more than 75% of the people killed in the tsunami that hit Southeast Asia in 2004 were women [32], which reveal that its impact was not gender neutral. Some authors consider that a possible explanation for this phenomenon could be related to traditional gender roles [31], such as the care and protection of other people (women looking out for others, rather than taking care of themselves), which in an emergency leads them to prioritize the safeguarding of their family and their belongings before their own lives.

The living conditions of women are also affected differently to those of men in disaster and postdisaster situations. For example, there is evidence of increased violence against women, such as occurred after the earthquake in Haiti in 2010 [1]. Other researchers have noted the impact of disasters on women's mental health [8] and reproductive health [35].

Another aspect not often analyzed is related to the socioeconomic impact caused by disasters. Some research suggests that low socioeconomic level increases the risk of suffering greater material losses during disasters [10], as well as hindering subsequent recovery [20,22,24,33]. Indeed, gender is considered a fundamental explanatory category to take into account when examining the effects of a disaster, both during and following it [13,16,23,30].

As some authors point out [16,17], within a context of scarcity, such as the situation that follows a catastrophe, women are often the first to, if necessary, sell their personal property to take care of their families,

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which results in their impoverishment. In addition, the loss of housing coupled with disasters not only influences the security and living conditions of women, but for the many who work on their own and informally in their homes it also implies a direct loss of their workplace and, therefore, their livelihoods. Moreover, postdisaster women face greater difficulties in re-entering paid work and often do not receive State aid as a priority because of the gender prejudices of social actors involved in reconstruction, who usually prioritize the return to employment of men. Additionally, during and after a disaster, girls and young women may see their education interrupted, which hinders their future independence [11,29,36].

An analysis of the literature shows that our knowledge of the impact of disasters on the living conditions of women is limited. On the one hand, the scientific production on this topic is recent and not extensive, and on the other, a good part of the research is from universities in the English speaking world and Asia and it focuses on the analysis of catastrophes linked to such territories. With this article, we attempt to extend existing knowledge of this issue in the Latin American and Caribbean area. Our objective is to analyze the effects that the earthquake that hit Haiti in 2010 produced on gender relations and, in particular, on the socioeconomic positions of men and of women. The question we seek to answer is whether the socioeconomic conditions of female-headed households worsened or improved following the catastrophe.

2. Methodology

The source of information for this article is the Demographic and Health Survey (DHS), compiled by the United States Agency for International Development (USAID). In our analysis we rely on the data from the survey from two time periods, 2005–06 and 2012, which relate to the periods before and after the disaster of 2010 and are disaggregated by sex, thus allowing us to analyze the gender impact of the event.

In the 2005–06 survey, 15,715 individuals from 9,998 households were interviewed, of whom 10,757 were women aged between 15 and 49 years. In 2012, the total number of households included was 13,181, comprising 23,770 individual interviews, 14,287 of which related to women aged between 15 and 49 years [12,28]. For this article, we used only the data from surveys completed by women who were the head of a household or were the partner or wife of the head of the household, since it is these that contain the variables relevant to our analysis, and not those completed by other women living in the same property, such as grandmothers, sisters, aunts, daughters, and visitors. In this way, we used only one survey per household and did not duplicate data for the same household, thereby avoiding distorting the sample.

To measure the impact of the earthquake on gender relations, we employ the quasi-experimental differences in differences (DID) technique, which uses longitudinal data from two population groups, treatment and control, to obtain an appropriate counterfactual that allows the estimation of a causal effect (Fig. 1). In this case the temporal variable (t) is considered at two points: for the predisaster period (i.e. data from 2005-6, $t = 0$), and the postdisater (data from 2012, $t = 1$) thus enabling the comparison of those homes affected by the earthquake and those which were not at these two points in time. This double difference comprises the expected change in WF in the treatment group (those affected) pre- and postdisaster minus that of the control group (those not affected) over the same period. The essence of the method is that the counterfactual is obtained by projecting the level of the result obtained from the people affected before the event with the variation rate observed for the results obtained from the control group over the time considered.

The intensity of the earthquake is measured by considering the average values for each 'department' (administrative area) on the island according to the Mercalli scale, calculated by Abigail Weitzman and Julia Andrea Behrman for Haiti [35] (Table 1). This scale evaluates the intensity of earthquakes through their destructive effects on people, homes, and infrastructure (USGS, 2019) and uses values between 1 (imperceptible earthquake) and 12 (total destruction with few survivors); a score of 5 or higher indicates the earthquake is strong. The average scores by department for the 2010 earthquake in Haiti range from 4.70 in the Nord department (moderate) to 7.97 in the Ouest department (very strong), enabling the 10 departments of Haiti to be classified into three categories: those with an average Mercalli scale score below 5 "Moderate disaster," those with an average score of between 5 and 7 "Strong disaster" ($D_2 = 1$), and those with an average score greater than 7 "Very strong disaster" ($D_1 = 1$).

Table 1
Intensity of the 2010 Haiti earthquake by department (according to the Mercalli Scale).

Region	Average Mercalli Score	Typical Deviation
Nord	4.70	0.55
Grand'anse	4.71	0.14
Nord-est	4.79	0.05
Nord-ouest	4.80	0.30
Artibonite	5.17	0.33
Sud	5.32	0.66
Center	5.33	0.33
Nippes	5.60	2.26
Sud-est	6.44	1.86
Ouest	7.97	1.42

Source: [35].

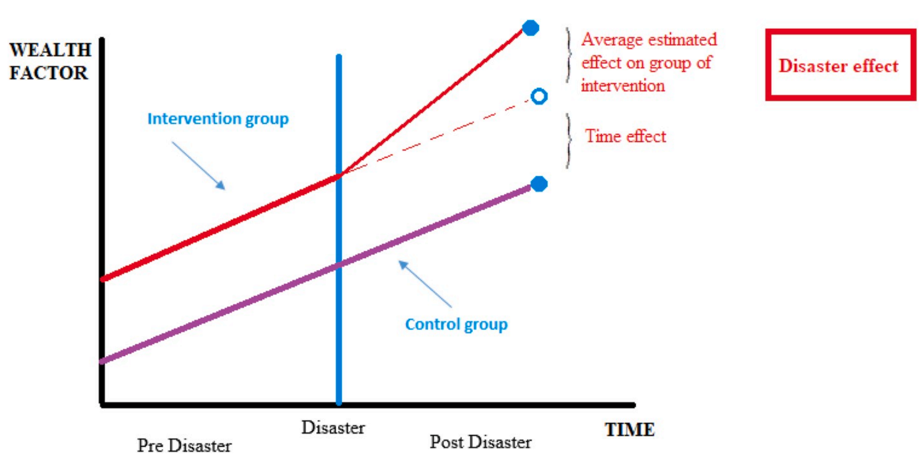

Fig. 1. Differences in differences estimation (DID).
Source: Graphic created by the authors based on [21].

As the purpose of this article is to quantitatively analyze the effects of the earthquake on gender relations and, in particular, determine whether the socioeconomic conditions of female-headed households improved or worsened after the catastrophe, we selected variables from the DHS survey that were relevant to this study question. Specifically, we used the variables "*Wealth Factor*" (*WF*) and "*Sex of Household Head*" (*SH*). The variable *WF*, a measure of the cumulative standard of living of a household, developed in collaboration with the World Bank, is a proxy comprising household income and expenses in several countries [19]. This variable therefore approximates the income of families, but it also incorporates the presence or absence of certain assets, for example, electricity, drinking water, bathrooms, appliances, the type of material the dwelling floor is made from, and means of transportation. The variable *SH* is a dichotomous variable that takes the value 1 if the individual is male and 0 otherwise. As the dependent variable of the regression, we use *WF* and, from the effect *SH* has on it and its interaction with the rest of the variables in the model, we estimate the effect of the disaster and its intensity on gender (in)equality.

The DID estimation is based on the interaction terms established between the different variables of the model. These terms reflect the estimated differential effect with respect to the base or control category, that is, surveyed households in areas of Haiti only moderately affected by the earthquake and led by women. Because systematic differences between the group affected by the event and the control group were very likely in our analysis, we needed to include observable variables that measure pre-existing characteristics, i.e. from before the disaster, particularly variables that vary over time [34]. We therefore used control variables which were not correlated with the earthquake but which explained variations in *WF*. The covariates are "*Age*" and "Age^2" of the head of the family, both reflect the effect of the life cycle on wealth. Likewise, the "*Number of children under 5 years of age*," "*Number of family members,*" and "*Cohabitation Status*" were also considered, the latter having a value of 1 if the woman lives with a partner (whether married or not) and 0 if not. We also take into account educational level through two variables: "*Primary Education*," which takes the value 1 if a woman has completed primary education and 0 otherwise, and "*Higher Education*," which has a value of 1 if a woman has completed secondary or higher education and 0 otherwise. Finally, we consider geographical area or "*Place of residence*," which takes the value 0 if it is rural and 1 if urban.

The DID model specification is:

$$WF_i = \beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3\, HS_i + \beta_4 t_i + \beta_5 (D_{1i}{}^*t_i) + \beta_6 (D_{2i}{}^*t_i) + \beta_7 (SH_i{}^*t_i) + \ldots + \beta_k X_{ki} + u_i$$

where u is the random disturbance term and X_k is each of the k covariates considered. As long as the value of each of the k covariates is not directly affected by the disaster, incorporating it does not limit the robustness of the model and allows for its effects on the dependent variable, effects due to observable characteristics, to be controlled for. Additionally, using the DID technique enables the control of effects caused by unobservable characteristics. If the assumptions of the multiple linear regression model are verified, the DID estimator with additional regressors will be an unbiased and consistent estimator [34].

3. Estimate and results

3.1. Analysis of the model assumptions

Before we estimated the model, we contrasted the key assumptions in the DID modeling. The first is the "assumption of common trends" or "parallel trends" [5], that is, that the indicators of interest follow the same temporal trajectory in the affected and control groups, which implies that in the absence of an earthquake, the average evolution of *WF* among people exposed and not exposed to the earthquake would be the same. If this assumption is not fulfilled, the estimates calculated through this methodology are not valid because the effect of the earthquake will be confounded with the different trend in each group. Although proving this assumption is not possible because the affected group cannot in fact be observed in the absence of the earthquake, some indication of its validity is provided by verifying the trends through the consideration of previous time periods. The results of the ordinary least squares regression

$$WF_i = \beta_0 + \beta_1 t_i + \beta_2 D_{1i} + \beta_3 D_{2i} + \beta_4 (t^* D_{1i}) + \beta_5 (t^* D_{2i}) + u_i$$

where t takes the value 1 if the observation corresponds to the year 2000 and 0 to the year 2005-6, and u is the random disturbance term allows us to assess whether the slope of the lines is statistically equal between the affected and control groups. The results of the estimate are shown in Table 2. Given that the term of interaction between time and the affected area is not statistically significant, we maintain the null hypothesis of parallel trends.

The DID estimate assumes the absence of contamination in the groups compared. In this regard, the migrations that occurred as a result of the earthquake were mainly from the Ouest department to other parts of Haiti. More than 1.2 million people were displaced to camps in Port-au-Prince and the surrounding areas [25], a situation that could bias the results. However, a key characteristic of the migrations in this case is that the majority of displaced people remained close to their places of origin or returned to them after a year [26]. To avoid this affecting the results we validated the proposed model using only data for households that remained in the same residence as when the 2005-06 survey was taken. The results obtained confirm our analysis because the sign and statistical significance of the variables considered remained stable in relation to those in the original regression (Table 3).

Another assumption made is that the covariates considered in the model for each of the groups analyzed remain stable from one survey to the next. Table 4 shows the descriptive statistics for the factors considered in the two surveys. The results of the analysis of comparison of means and proportions suggest that the sample means are stable, although the null hypothesis is not maintained for the variables related to age, education, and place of residence. This may, as mentioned previously, be due to mortality or migration resulting from the disaster, and thus, the model is validated by considering only households that remained in their place of residence during the period studied. This analysis supports the results obtained (Table 3).

Table 2
Parallel trends assumption.

Dependent variable: *WF* - Wealth factor

variable	Coefficient	Std. Error	t - Statistic	Prob.
C	−0.336206	0.014386	−23.37108	0.0000
D_1	1.538068	0.018803	81.79946	0.0000
D_2	−0.089867	0.018066	−4.974390	0.0000
t	0.216184	12.26726	0.017623	0.9859
$D_1{}^*t$	−0.551731	18.67720	−0.029540	0.9764
$D_2{}^*t$	−0.009567	16.60559	−0.000576	0.9995

Statistics

R-squared	0.528865	Mean dependent var	0.046788
Adjusted R-squared	0.528634	Akaike info criterion	2.165971
Sum squared resid	5214.600	Schwarz criterion	2.170216
Log likelihood	−11064.28	Hannan-Quinn criter.	2.167407
F-statistic	2293.561	Prob(F-statistic)	0.000000

Method: Ordinary Least Squares using DHS population weights. Huber-White-Hinkley (HC1) Heteroscedasticity consistent standard error and covariance. N = 10,222.
Source: Table created by the authors based on information from DHS

Table 3
Absence of contamination assumption.

Dependent variable: *WF*- Wealth factor				
Variable	Coefficient	Std. Error	t - Statistic	Prob.
C	−1.698090	0.171907	−9.877971	0.0000
D_1	1.256861	0.130183	9.654547	0.0000
D_2	0.300890	0.138304	2.175568	0.0296
t	0.055405	0.127537	0.434424	0.6640
D_1*t	−0.886008	0.132236	−6.700185	0.0000
D_2*t	−0.272958	0.141206	−1.933046	0.0533
SH	−0.046643	0.042207	−1.105104	0.2692
SH*t	0.127252	0.041998	3.029948	0.0025
Age	0.043753	0.005909	7.405046	0.0000
Age^2	−0.000438	6.89E-05	−6.358948	0.0000
Primary Education	0.685289	0.022464	30.50617	0.0000
Higher Education	1.549694	0.043289	35.79841	0.0000
Place of residence	0.944571	0.022984	41.09672	0.0000
Children aged under 5 years	−0.115135	0.013116	−8.777917	0.0000
Number of family members	0.013012	0.005491	2.369648	0.0178
Cohabitation Status	0.026096	0.020746	1.257876	0.2085

Statistics			
R-squared	0.634558	Mean dependent var	0.182045
Adjusted R-squared	0.633351	Akaike info criterion	2.376300
Sum squared resid	2852.758	Schwarz criterion	2.398853
Log likelihood	−5399.588	Hannan-Quinn criter.	2.384242
F-statistic	525.7853	Prob(F-statistic)	0.000000

Method: Ordinary Least Squares using DHS population weights. Huber-White-Hinkley (HC1) Heteroscedasticity consistent standard error and covariance. N = 4558.
Source: Table created by the authors based on information from DHS.

3.2. Results

The results of the DID estimate using the survey weightings from the DHS are shown in Table 5. The estimators are statistically significant, and the contrasts of global significance using the Wald F-statistic test (101.8234) and the $F-statistic$ test (267.4076) indicate that the model is globally significant at a level of 99.99%. The collinearity indicators do not show any significant problems of linear association between the explanatory variables of the model, except for the variables *SH*, *Age*, and Age^2, which have a VIF greater than 10 and eigenvalues close to 0. The Breusch-Pagan-Godfrey contrast visualizes the presence of heteroscedasticity in the model ($F-statistic = 371.2495,\ p-value = 0.00001$); thus we consider standard errors and robust covariances.

The fixed effects of zone are collected through the variables $D_1(0.858043)$ and D_2 (0.284785), which exert a positive and statistically significant effect on the *WF* of households ($p-value = 0.0000$ and $p-value = 0.00001$), respectively). The fixed effect of inequality in household wealth due to sex is collected through the *SH* variable, and its effect on the model is greater for men than for women (0.000486) although the difference is not statistically significant ($p-value = 0.9937$) because of its multicollinearity.

The fixed effects related to the 2012 period are those included in the parameter that accompanies the temporal variable *t* and they were found to be negative (−0.223752) and statistically significant ($p-value = 0.0000$) for the year 2012, indicating a fixed post-earthquake negative differential effect in the *WF* of families.

By using the term of interaction with the variable *SH*, we observed that these negative effects intensify when the household is headed by a woman, i.e. the gap between the wealth of households headed by women and those that are not widens. The term of interaction between the variable *SH* and the temporal variable highlights a differential effect between the pre- and postearthquake states of the fixed effects on *WF* because of *SH*. That is, the effect is positive (0.127277) and statistically significant ($p-value = 0.0439$), indicating that the wealth of female-led families decreased in relation to that of male-led families following the disaster.

The estimate also shows there is a fixed negative effect of zone on the wealth of families that increases with the intensity of the impact of the earthquake in the different zones, and that it is statistically significant, regardless of the gender of the head of the family. The multiplicative effect of earthquake exposure based on its intensity is captured by the interaction term between the variables that define zone, D_1 and D_2, and the temporal variable, *t*. In households located in areas where the earthquake was very strong, D_1 , the sign of the DID estimator was negative (−0.564964) and statistically significant ($p-value = 0.0000$), a pattern repeated, though to a lesser degree, for families residing in areas where the intensity of the earthquake was strong, that is, D_2, where the DID estimator was also negative (−0.286166) and statistically significant ($p-value = 0.0000$). Thus our results indicate that the effect is greater the greater the intensity of the impact of the disaster.

The signs and statistical significance of the covariates considered here are consistent with the postulates of economic theory. The theory of human capital establishes that higher salary levels are associated with higher levels of human capital: the education, training, skills, and experience of the worker [6,27]. The sign of the estimation of the parameters is associated with the variables "*Primary Education*" (0.313107) and "*Higher Education*" (0.713646) and their statistical significance, ($p-value = 0.0000$ and 0.0007, respectively) is in line with the theory. Likewise, age, experience, family, cognitive abilities have particular relevance when explaining the accumulation of human capital because of their impact on an individual's type of employment and,

Table 4
Descriptive statistics.

	2005–06			2012		
	Moderate disaster zone	Strong disaster zone	Very strong disaster zone	Moderate disaster zone	Strong disaster zone	Very strong disaster zone
Age	38.3223 (0.2381)	38.9012 (0.2123)	36.618 (0.2573)	38.4563* (0.2237)	38.9675 (0.2028)	36.341* (0.1978)
Primary education	0.2164 (0.0099)	0.2090 (0.0089)	0.3935 (0.0134)	0.2866* (0.0102)	0.2662 (0.0091)	0.4292 (0.0099)
Higher education	0.0176 (0.0031)	0.0132 (0.0025)	0.08223 (0.0075)	0.0236* (0.0046)	0.0233* (0.0031)	0.07723 (0.0053)
Place of residence	0.4305 (0.0119)	0.3232 (0.1026)	0.7101 (0.0125)	0.3597* (0.0108)	0.2286* (0.0086)	0.7102 (0.0091)
Children aged under 5 years	1.0921 (0.02311)	1.1042 (0.02213)	0.8199 (0.0276)	0.9964* (0.02176)	1.0221* (0.019)	0.7329* (0.0201)
Number of family members	5.5486 (0.0568)	5.3998 (0.0502)	4,7871 (0.6176)	5.4997 (0.0522)	5.2982 (0.0468)	4,4052* (0.0411)
Cohabitation Status	0.6394 (0.0115)	0.6459 (0.0104)	0.6652 (0.0133)	0.6801 (0.0105)	0.6655* (0.0097)	0.6699 (0.0094)

Note: Means and Standard Deviation (in brackets) are given. * denotes that $p < 0.01$ in the contrast of the t-Student of comparison of means and proportions for each of the waves of the surveys by zone of earthquake intensity. Sample sizes: Moderate disaster zone (N2005 = 1,728, N2012 = 1957) Strong disaster zone (N2005 = 2,076, N2012 = 2345); Very strong disaster zone (N2005 = 1.311, N2012 = 2.460).
Source: Table created by the authors based on information from DHS.

Table 5
Estimation of the effect of the 2010 Haiti disaster on gender inequality. Differences in differences model considering earthquake intensity zones.

Dependent variable: *WF*- Wealth factor

Variable	Coefficient	Std. Error	t - Statistic	Prob.
C	−1.161285	0.201413	−5.765689	0.0000
D_1	0.858043	0.052927	16.21173	0.0000
D_2	0.284785	0.060733	4.689149	0.0000
t	−0.223752	0.050104	−4.465728	0.0000
D_1*t	−0.564964	0.057593	−9.809626	0.0000
D_2*t	−0.286166	0.056216	−5.090458	0.0000
SH	0.000486	0.061766	0.007876	0.9937
SH*t	0.127277	0.063152	2.015402	0.0439
Age	0.043753	0.009980	4.384146	0.0000
Age^2	−0.000573	0.000117	−4.895675	0.0000
Primary Education	0.313107	0.044578	7.023827	0.0000
Higher Education	0.713646	0.210590	3.388797	0.0007
Place of residence	0.262342	0.038946	6.736103	0.0000
Children under 5 years	−0.089533	0.024441	−3.663192	0.0003
Number of family members	0.012038	0.011858	1.015224	0.3100
Cohabitation Status	0.028443	0.039113	0.727191	0.4671

Statistics

R-squared	0.252715	Mean dependent var	−0.020772
Adjusted R-squared	0.251769	Akaike info criterion	1.661053
Sum squared resid	3651.307	Schwarz criterion	1.670998
Log likelihood	−9848.163	Hannan-Quinn criter.	1.664391
F-statistic	267.4076	Prob(F-statistic)	0.000000

Method: Ordinary Least Squares using DHS population weights. Huber-White-Hinkley (HC1) heteroskedasticity consistent standard error and covariance. Sample sizes: Moderate disaster zone (N2005 = 1,728, N2012 = 1957) Strong disaster zone (N2005 = 2,076, N2012 = 2345); Very strong disaster zone (N2005 = 1.311, N2012 = 2.460). Total observations included: 11,877.
Source: Table created by the authors based on information from DHS.

consequently, their income. The inclusion of the variable “*Age^2*” allows us to collect the parabolic form of the function, and each additional year has a lesser effect on income than the previous one. The signs of the parameters associated with “*Age*” reflect its positive influence on *WF* $(0.043753, p-value = 0.0000)$ up to a maximum after which it decreases $(-0.000573, p-value = 0.0000)$.

Scientific evidence suggests that the impact of maternity on wages is negative because of a decrease in work experience as a result of taking responsibility for both the care and education of children [6,27]. This phenomenon is reflected in the sign and statistical significance of the estimation of the parameter associated with “*Children under 5 years*” $(-0.089533, p-value = 0.0003)$, which shows how maternity is linked to a reduction in household wealth. On the other hand, the parameter “*Number of family members,*” considers the effect of the participation in the labor market of all household members as many of them have both job. In fact, the productive structure of Haiti, marked as it is by 80% of jobs being informal, the strong polarization between the primary and tertiary sectors, and practically 40% of children aged between 7 and 14 being involved in paid activities [37], results in this parameter having a positive effect (0.012038) although it does not reach significance $(p-value = 0.3100)$, probably as a consequence of collinearity in the explanatory variables.

Lastly, in 65.72% of the households sampled, the woman lives with a partner, compared with 34.28% who do not. The effect of the presence of a couple on household wealth was found to be positive but not significant $(0.028443, p-value = 0.4671)$.

Finally, we carried out a robustness analysis to ratify our results. We estimated an auxiliary regression using the average intensity of the disaster by department, (*I*) (Table 1) as an indicator of the magnitude of the disaster. The estimated model corresponds to the specification:

$$WF_i = \beta_0 + \beta_1 I_i + \beta_2 HS_i + \beta_3 t_i + \beta_4 (I_i * t_i) + \beta_5 (HS_i * t_i) + \ldots + \beta_k X_{ki} + u_i$$

The results we obtained (Table 6) correspond in terms of sign and significance with those obtained for the original model, thus confirming our results.

4. Conclusions and recommendations

This article has analyzed the socioeconomic impact of the 2010 Haiti earthquake on gender relations, demonstrating how gender inequalities persisted, and indeed intensified after the disaster. The results reaffirm those already in the literature, that is, disasters do not produce equal consequences for the entire population of the country affected, but rather cause greater vulnerability in those groups that are least protected [3,4,9,14].

There is some scientific evidence demonstrating that women are particularly vulnerable during, and especially following, natural disasters, with negative impacts on their reproductive health, increased violence against them, and disruption to and a reduction in their access to education and employment [2,10,15,16,30].

Notably, no study prior to this one had analyzed how natural disasters affect gender inequality according to the level of household wealth; thus, we attempted to fill this gap. Determining the impact of disasters on gender relations from a quantitative point of view was not an easy task. On the one hand, we lacked official sources of information that were disaggregated by sex which would allow the quantitative analysis of this phenomenon, both at the macro- and the microeconomic level. On the other, to measure the impact of a catastrophe on the population, longitudinal data is necessary to visualize the differences between the time before and after the disaster. The DHS survey used in this article, together with the DID methodology, allowed us to overcome these difficulties and carry out the analyses.

The results obtained indicate that the general socioeconomic reality

Table 6
Estimation of the effect of the 2010 Haiti disaster on gender inequality. Differences in differences model considering the average intensity of the earthquake by department.

Dependent variable: *WF*- Wealth factor

Variable	Coefficient	Std. Error	t Statistic	Prob.
C	−1.150914	0.064713	−17.78503	0.0000
I	0.053576	0.003827	13.99956	0.0000
SH	0.010232	0.003261	3.137923	0.0017
t	−0.197870	0.028846	−6.859597	0.0000
I*t	−0.021710	0.004218	−5.146782	0.0000
SH*t	0.055106	0.025726	2.142071	0.0322
Age	0.043052	0.003284	13.11134	0.0000
Age^2	−0.000567	4.25E-05	−13.35796	0.0000
Primary Education	0.320138	0.011773	27.19168	0.0000
Higher Education	0.730445	0.035992	20.29451	0.0000
Place of residence	0.276141	0.011081	24.92036	0.0000
Children under 5 years	−0.090247	0.006880	−13.11812	0.0000
Number of family members	0.009597	0.003171	3.026838	0.0025
Cohabitation Status	0.028008	0.010922	2.564466	0.0103

Statistics

R-squared	0.241992	Mean dependent var	−0.020772
Adjusted R-squared	0.241161	Akaike info criterion	1.674963
Sum squared resid	3703.698	Schwarz criterion	1.683665
Log likelihood	−9932.766	Hannan-Quinn criter.	1.677883
F-statistic	291.3255	Prob(F-statistic)	0.000000

Method: Ordinary Least Squares using DHS population weights. Huber-White-Hinkley (HC1) heteroskedasticity consistent standard error and covariance. Total observations included: 11,877.
Source: Table created by the authors based on information from DHS.

of Haitian families after the disaster worsened and that the negative impact of the earthquake increased with the intensity of the catastrophe's effects in the different administrative departments on the island. This situation was exacerbated for households led by women and resulted in an increase in the gap between the wealth of households headed by women and that of other types of household. The dependent variable used in the analysis attempts to reflect the living conditions of the individuals who reside in the homes studied in that it includes aspects such as the existence of electricity, drinking water, bathrooms, appliances, the type of material the dwelling floor is made of, and means of transportation. As such, these results constitute a better reflection of the wealth and well-being of households than the mere analysis of monetary wealth. Although Haiti has the lowest incomes in Latin America, our analysis reflects the fact that family behavior with respect to the variables traditionally used to measure wealth in economic terms is similar to that of other territories, i.e. variables such as education, age, and presence of children under 5 influence wealth, in accordance with the postulates of the theory of human capital.

These conclusions reinforce the idea that natural disasters have a negative impact on women and, in particular, on the economic possibilities of households headed by women, and show that, at least in Haiti, the enormous gender inequalities that existed prior to earthquake do not decrease postdisaster, but, rather, they are exacerbated.

These findings have at least three main political implications. First, the production of statistics and data disaggregated by sex are necessary in order to understand the impact of disasters on gender relations, which would be in accordance with the recommendations of the United Nations Office for Disaster Risk Reduction (UNDRR). Second, despite the fact that in recent decades progress has been made in incorporating the gender perspective into disaster risk management in Latin America and the Caribbean, as well as internationally, particularly in terms of Sustainable Development Objectives and Agenda 2030 [7,18], institutional efforts have not been effective enough. Finally, this article clearly highlights a connection between gender and poverty, thereby revealing the intersectional nature of the inequalities that women face. This fact demands that risk management policies incorporate an intersectional perspective to maximize their effectiveness. In the area studied here it would be crucial to implement public policies aimed at reducing the feminization of poverty, in particular those that address its causes, in order to increase women's capacity to confront natural disasters as well as deal with and recover from their aftermath.

Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2020.101693.

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