Original Article

Economic Effects of 1978 Tabas Earthquake (Iran)

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Abstract

Background: Natural disasters are one of the most important adverse health events. The earthquake that happened in the city of Tabas in 1978 was ranked third in terms of number of deaths caused by natural disasters over the past 100 years in Iran. This study was aimed to evaluate the economic and human capital consequences of earthquake in Tabas district.

Method: We used a two percent random sample of Iran Census Dataset from 2006 to run a difference-in-difference study. The difference-in-difference methodology was used to evaluate (1) the mean changes in variables including years of schooling and wealth; (2) the odds changes in primary school completion and literacy of people born (5 or 10 years) post-event versus (5 or 10 years) pre-event in Tabas compared with the same values for those born in the same period of time in the control districts.

Results: Differential increase in years of schooling for being born 10 years after the earthquake versus in 10 years before earthquake in Tabas was one-third of a school year less than in the control districts. There were 89.5% and 65.4% decrease in odds that an individual is literate, and 0.26 and 0.104 average decrease in the SES index for those born in Tabas in periods of 5 and 10 years, respectively, compared with control districts.

Conclusion: Tabas earthquake had negative long-term effects on human capital and wealth. This study can help official authorities to promote educational and economic plans and to implement comprehensive reforms in earthquake-stricken areas.

Keywords: Earthquake, human capital, wealth and health

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Introduction

Natural disasters are known as one of the most important health-related socioeconomic parameters,[1] which lead to extensive human, economic or environmental damages that cannot be handled and managed using the resources of the affected community.[2] Since each area is differently vulnerable to disasters and social, health, and economic conditions are effective factors in determining the level of vulnerability, every disaster is considered to be distinctive and matchless.[3,4]

Natural disasters are associated with serious consequences on people's physical and mental health.[5] There are many health-related problems occurring after disasters that can hinder people's access to vital needs, including: (1) interruption of service delivery by the healthcare systems; (2) reduced availability of food and malnutrition; (3) increase in population density in the affected areas; (4) interruption of service delivery in public systems (such as damage to sources of drinking water, lack of access to healthy water and interruption of sewerage collection systems and urban cleaning services); (5) Increase in the incidence of communicable diseases; (6) Loss of home and lack of healthy toilets.[6]

Human injuries and losses of human lives in the affected areas lead to the loss of human capital. The human capital is an effective factor required for the economic growth.[7] Damage to the educated people, teachers, schools and infrastructures can interrupt the delivery of educational services after disasters; On the other hand, the devastating economic effects of disasters can thereaten educational outcomes.[8] Natural disasters destroy productive assets such as infrastructure, means of production and reserves[9] and lead to adverse effects on economic growth, poverty reduction and development.[10] As a result, human losses, destruction of buildings and schools, losses of job and income and damage to the local economy can lead to long-term effects on human capital and regional economies.[1,11]

The impacts of disasters are associated with their type; earthquakes are often followed by more serious injuries which need special heath care.[6] Moreover, most of natural disasters-related deaths are associated with earthquakes[12] and the greatest number of deaths from these events occurs in developing countries.[13] Natural disasters are more common in Asia than any other area in the world[14] and Iran is one of the world's top ten countries in terms of the frequency of natural disasters.[15] Iran has experienced devastating earthquakes during the past century.[16] According to EM-DAT database compiled by the Centre for Research on the Epidemiology of Disasters (CRED), totally 103 earthquakes were recorded in Iran for the 1900-2013 period, which killed 147,466

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people, affected 2,677,761 people and caused 11,018,628 million USD damage in this country. The massive earthquake that happened in the city of Tabas in 1978 killed around 25,000 people and was ranked third in terms of number of deaths caused by natural disasters over the past 100 years in the country. Moreover, this earthquake is associated with 40,000 people affected and 50 million USD damage in the Tabas district.[12]

Due to the need for epidemiological studies of natural disasters, especially earthquakes in Iran, this paper was aimed to evaluate the economic and human capital consequences of Tabas earthquake. We assessed the effects of earthquake as an adverse health event in the time of birth or childhood on education and socioeconomic outcomes in adulthood.

Materials and Methods

Data and subjects

In this difference-in-difference study, we considered a natural event (earthquake) as an intervention and compared the changes before and after it. List of natural disasters in Iran was taken from the Centre for Research on the Epidemiology of Disasters (CRED). In order to register an event as a disaster in this center, the disaster must fulfill at least one of the following criteria: (1) Ten or more people reported killed; (2) Hundred or more people reported affected; (3) State of emergency declaration; (4) Call for international assistance is issued.[12] In addition, another list of natural disasters was taken from Department of Disaster Public Health (School of Public Health, Tehran University of Medical Science). Accordingly, we identified the names of districts with a history of natural disasters until 2006 based on EM-DAT report and excluded all except Tabas district. We chose Tabas earthquake because it is one of the most devastating disasters. Furthermore, it is old enough to have those with an expected educational and financial stability after the earthquake. The Statistical Center of Iran has provided 2% of Iran Census Dataset from 2006 with 1,367,310 observations (using systematic random sampling) for users. Stratified simple random sampling was used for the 2% of the census files. The rural and urban areas within districts were used to stratify the observations and the sampling portion in each category was 20%. We used this data to determine the socio-economic status (SES) index of districts. The SES index was formed using principal component analysis and the districts were divided into quartiles based on the SES index of district. Tabas was in the second quartile with other 55 districts, which had no experience of natural disaster until 2006 and were assumed similar to Tabas in terms of SES index. These districts were selected as control group in the study. Finally 45,194 people were enrolled in the study, which included birth cohorts 1968-1988 (except 1978, the year of earthquake). The collected data was analyzed using statistical software Stata 11.0.

Difference-in-difference method

The difference-in-difference methodology was used to estimate the effects of earthquake on educational and economic progress in Tabas compared with the other control districts. We had four groups: people born in Tabas district (before and after the event) and people born in control districts (before and after the event). The pre-event was defined as two periods of 5 and 10 years before 1978 and post-event as two periods of 5 and 10 years after 1978. We used D-in-D specification to estimate the model:

$$Yi = \beta_0 + \beta_1 T_1 + \beta_2 K_1 + \beta_3 (T+K) + \beta_4 X_i + \varepsilon i \quad (1)$$

Where Yi is the outcome of interest for individual i including years of schooling, primary school completion, literacy and wealth. We used T =1 to denote the birth post-event and T=0 to denote the birth pre-event. K is a binary variable for birth in Tabas district or control districts. β_3 is coefficient on the interaction between T and K . It is noteworthy that this is a dummy variable that takes the value of one only for being born in Tabas district in the post-event period. The coefficient of our interest is β_3 which gives possible; (1) mean changes in outcome variables (years of schooling and SES index) and (2) odds changes in primary school completion and literacy for the people born in post-event period versus those born in pre-event period in Tabas district compared with those born in the same period of time in the control districts. The confounding variables such as gender, marital status, religion, residency area and nationality were controlled in matrix X .

Socio-economic status (SES) index

Iran's 2006 census dataset includes household asset variables. Items of household and housing questionnaire were obtained according to recommendations of United Nations and requests or users as governmental organizations. We used principal component analysis to create socio-economic status (SES) index for subjects. Twenty nine variables such as type of water supply, cooking fuel, electricity, internet, and telephone were used. Finally, 23 asset variables remained in the model and the variance of the first component was 0.233. Thus, the SES index was created as a measure of household wealth and this variable was used as dependent variable in model (1).

Results

Table 1 presents descriptive information about people in Tabas and control districts. In this study, over half of the residents of Tabas are urban, while control group rural people are more than urban people.

In Tabas, the percentage of female population was slightly more than men, while in control districts the male population was greater.

Except in the pre-event control group, literacy was over 95% in all other groups. Literacy percentage and primary school completion were higher in Tabas district. Average of years of schooling for people born in Tabas district, 10-years before event was 1.13 years more than the control districts.

Tables 2 and 3 show the results found in equation (1) for people who were born 5 and 10 years before and after the event. We found that the β_3 coefficient for years of schooling was only significant in 10-year period and was -0.34 (P-value = 0.011), indicating that the differential increase in years of schooling for those born in Tabas after the earthquake versus those born before it was one-third of a year less than the control districts. The β_3 for literacy for the 5- and 10-year periods were -2.25 (P-value = 0.00) and -1.06 (P-value = 0.00), respectively, and both were significant. These imply 89.5% and 65.4% decrease in odds that an individual is literate for those born 5 and 10 years post-event in Tabas, respectively, versus control districts.

We found that people of Tabas in both periods had significantly lower SES indices than the control districts. The β_3 for SES index for the 5- and 10-year periods were -0.26 (P-value = 0.00), -0.104 (P-value = 0.002), respectively. These show that being born in

Table 1. Comparison of Tabas and control districts.

	Tabas		Control districts	
5-years before and after earthquake	**Pre-event**	**Post-event**	**Pre-event**	**Post-event**
Years of Schooling	8.290	9.497	7.136	8.311
Primary School Completed	87.71%	95.37%	77.24%	88.39%
Literacy	99.32%	97.73%	89.40%	95.34%
Age	30.87	24.50	30.72	24.70
Female	50.34%	52.13%	46.75%	46.24%
Muslim	100%	100%	99.98%	99.87%
Married	91%	63.66%	79.42%	52.67%
Widow & widower	0%	1.09%	0.55%	0.23%
Divorced	1.53%	0.64%	1.19%	0.60%
Single	7.47%	34.61%	18.85%	46.50%
Urban	51.68%	55.39%	39.47%	40.03%
Iranian	100%	100%	99.87%	99.91%
SES index	-2.30	-2.70	-1.80	-2.12
N	122	228	8,786	12,828
10-years before and after earthquake				
Years of Schooling	7.665	9.276	6.535	8.378
Primary School Completed	81.64%	93.88%	70.99%	90.04%
Literacy	94.53%	96.53%	85.12%	95.93%
Age	32.92	21.94	33.03	21.85
Female	51.57%	52.5%	45.96%	49.01%
Muslim	100%	99.24%	99.79%	99.63%
Married	94.43%	43.31%	84.09%	34.77%
Widow & widower	0%	0.51%	0.86%	0.17%
Divorced	0.89%	0.68%	1.14%	0.39%
Single	4.67%	55.50%	13.91%	64.67%
Urban	53.51%	54.52%	39.95%	39.4%
Iranian	100%	99.83%	99.89%	99.80%
SES index	-2.33	-2.74	-1.69	-2.16
N	206	474	16,137	28,377

Table 2. Estimates of equation (1) with 5-years before and after event for dependent variables (b/se).

Dep Var	**Years of Schooling**	**Primary school completion**	**Literacy**	**SES index**
Post-earthquake	0.533***	0.47***	0.435***	-0.194***
	(0.034)	(0.027)	(0.045)	(0.008)
Tabas	-0.395	0.56***	2.369***	-0.759***
	(0.262)	(0.14)	(0.51)	0.033
Post* Tabas	**-0.917**	**0.174**	**-2.254*****	**-0.258*****
	(0.189)	(0.19)	(0.543)	(0.038)
Female	-1.091***	-1.164***	-1.098***	-0.479***
	(0.021)	(0.017)	(0.025)	(0.018)
Urban	3.118***	1.507***	1.569***	3.228***
	(0.022)	(0.021)	(0.033)	(0.005)
Non-Muslim	0.253	-1.173	0.092	-0.582***
	(0.372)	(0.303)	(0.048)	(0.109)
Non-Iranian	-1.257***	0.065	0.088	0.428***
	(0.342)	(0.292)	(0.439)	(0.023)
Widow & widower	-0.835***	-0.22	-0.704***	0.876***
	(0.174)	(0.112)	(0.123)	(0.038)
Divorced	-0.414***	-0.108	-0.029	-0.015
	(0.115)	(0.079)	(0.108)	(0.046)
Single	0.918***	0.192***	0.262***	0.178***
	(0.023)	(0.019)	(0.028)	(0.014)
N	122,091	123,411	123,411	414,898
*$P < 0.05$, ** $P < 0.01$, ***$P < 0.00$				

Table 3. Estimates of equation (1) with 10-years before and after event for dependent variables (b/se).

Dep Var:	Years of Schooling	Primary school completion	Literacy	SES index
Post-earthquake	0.801***	0.435***	0.370***	-0.183***
	(0.027)	(0.022)	(0.03)	(0.007)
Tabas	-0.615**	0.625***	0.888***	-0.658***
	(0.189)	(0.094)	(0.152)	(0.025)
Post* Tabas	**-0.347***	**-0.204**	**-1.066*****	**-0.104*****
	(0.135)	(0.125)	(0.184)	(0.033)
Female	-0.992***	-1.128***	-1.122***	-0.298***
	(0.014)	(0.012)	(0.016)	(0.013)
Urban	2.95***	1.515***	1.440***	3.253***
	(0.014)	(0.014)	(0.02)	(0.004)
Non-Muslim	0.544*	-0.028	0.316	-0.343***
	(0.23)	(0.208)	(0.321)	(0.082)
Non-Iranian	-2.846***	-1.526***	-1.980***	0.353***
	(0.173)	(0.118)	(0.133)	(0.019)
Widow & widower	-1.779 ***	-0.688***	-0.943***	0.407***
	(0.11)	(0.069)	(0.072)	(0.023)
Divorced	-0.418***	-0.125*	-0.097***	-0.127***
	(0.087)	(0.06)	(0.075)	(0.032)
Single	0.794***	0.217***	0.284***	0.225***
	(0.017)	(0.014)	(0.02)	(0.011)
N	258,333	260,087	260,202	711,538

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

Tabas after earthquake versus before it is more associated with 0.26 and 0.104 average decrease in SES index compared to the control districts. We evaluated the changes in SES indices in similar 5-year groups for both urban and rural (results not shown) and β_3 for rural and urban population were -0.414 (*P*-value = 0.00) and -0.0008 (*P*-value = 0.98), respectively, which was only significant for rural areas at 5%.

The β_3 coefficient was not significant in any period for primary school completion at 5%.

Discussion

The Tabas earthquake had negative effects on years of schooling, literacy, and SES index; the educational and economical progresses in post-earthquake Tabas had decreased compared with the control districts.

In this study, we did not explore enrollment in secondary school or higher levels; however, in Cuaresma's study (2010), the relation between natural disasters and secondary school enrollment was investigated in a period of 20 years in 80 countries and it was found that in countries at risk of natural disasters, there is a 2.13% decline in secondary school enrollment compared with the countries in which the risk of disasters is zero.[8] Kim (2010) found negative and statistically significant relationship between tertiary school enrollment and geologic disasters.[17] So, it seems that negative educational progress in post-earthquake Tabas is possibly associated with higher educational level, because mean change primary school completion variable was not significant between Tabas and control districts and mean years of schooling of Tabas was higher than 5 years. According to the results of a study by Kim N (2010), the 1990 drought in Cameroon reduced the rate of primary school completion of affected women by 8.7% but in Burkina Faso, the 1988 drought did not have a statistically significant impact on primary school completion.[18]

When we estimated SES index using PCA, we selected all districts that exist in the same quartile as Tabas. Considering the fact that Tabas is relatively a poor district, we expect to have a lower range of SES index in Tabas which is in this case, a negative number. The situation was the same for all districts in Tabas's SES index quartile, with negative numbers for all of them. It should be mentioned that among all districts, Tabas is in second quartile of SES index and residents have lower SES index than the residents of control districts. This concludes that devastating earthquakes result in more adverse outcome in districts with low SES, like Tabas. Furthermore, such earthquakes in districts like Tabas, lead to a vicious cycle in terms of poor economic growth. Noy (2006) supports this observation in his study, concluding that natural disasters in developing countries cause a sharper decline in production as compared to the production in developed countries after natural disasters.[19] In a study, Hochrainer (2009) indicated that when income of countries is low, natural disasters result in more negative economic impacts.[20] Differences in SES of individual person at the time of exposure can cause heterogeneity in effects of natural disasters.[21] In this study, we used only post-event economic data by categorizing theirarea of residence as urban or rural. We observed that mean of SES index in rural areas of Tabas was less than urban areas (-3 & -.18, respectively). Moreover, major negative impact as a result of earthquake was linked to rural areas. Rural areas are more vulnerable to disaster because of several factors such as geography, capacity management, economy and ability of asset recovery and redevelopment.[22] The 1998 hurricane in Honduras increased the extreme poverty rate from 46% to 49% and because of the hurricane, rural areas were more affected by the poverty.[23] So in the rural areas, appropriate building materials are not used, and reconstruction and providing services occur later than in urban areas. As a result, these can lead to more adverse effects.

Significant economic impacts of earthquake on 5-year birth cohort were greater than 10-year birth cohort as the earlier cohort was closer to the earthquake and was affected more severely. The

important issue in this regard is the amount of time needed to recover the lost assets of individuals to the pre-earthquake levels; this has been one of the obstacles in economic growth at household level.[21] On the other hand, due to the mortality from natural disasters, there is a reduction in labor force, compelling orphans to work at an early age, finally reducing educational outcomes and incomes.[24] Kirigia *et al*. (2004) estimated that a single death due to natural disaster results in decline of US$ 0.01828 in GDP of 46 African countries.[25] Kim N (2010) stated that in case wild fire did not happen in Magnolia, the average wage for each work per week per year would be around 2.8% more.[18]

This analysis theoretically indicates the negative long-term effects of natural disasters on human capital and wealth. We demonstrate that Tabas earthquake has led to decreased educational progress and SES index in adulthood. Controlling the effects of disasters requires special management, training and public collaboration. Effective measures (such as retrofitting buildings, buildings insurance and regulations) must be adopted prior to such events to reduce initial losses. This will lead to a reduction in subsequent long-term adverse effects in a country. Health care pattern and social needs will change after the natural disaster, thus requiring a revision of collaboration and enterprise applications (such as health care, social welfare, education, employment and reconstruction).

This study can help policy makers to promote educational and economic planning and to implement comprehensive reforms in earthquake-stricken, especially rural, areas. It seems that continuing education after primary school is a post-earthquake problem and birth cohorts closer to earthquake are more vulnerable to economic effects, should be noticed more by government policies. There is a need to correctly understand the causal relationships related to the outcome of natural disaster, hence this study could be a useful tool that attracts the necessary funds for studies related to natural disasters in the future.

This study had some limitations. Because of the use of secondary data (census), we were not able to determine the reasons for leaving school and illiteracy. Educational attainments are different between the districts and part of the changes in means of variables might be due to this fact. It was better to use pre-earthquake information to select control districts than post-earthquake information, but we didn't have access to the pre-earthquake data. Immigration is one of the potential factors affecting education and economic status in people who have suffered from the earthquake. Therefore, to control this factor, we studied only individuals born and living in Tabas and the control districts, but, some of those who previously immigrated returned to their homelands after a while. As one of the other limitations of this study, we did not identify and categorized this group of people.

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