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Pain of disasters: The educational cost of exogenous shocks evidence from Tangshan Earthquake in 1976

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ABSTRACT

Based on a random sample from 1 percent population survey data of 2005, this paper studies the impacts of Tangshan Earthquake on the educational attainment and subsequent labor market outcomes of affected cohorts using the methodology of difference-in-differences model and the local average treatment effect interpretation of instrumental variables technique. We find that the schooling years of the cohorts potentially affected by Tangshan Earthquake is 14%–21% of a year of schooling lower than the non-earthquake cohorts, which can be considered as the shortterm educational cost of Tangshan Earthquake. The rate of returns to years of schooling for the earthquake cohorts is 20.93%–27.85%. The earthquake leads 3.51%–4.77% loss of average income through the reduction of schooling years. A loss of 0.30%–0.41% of GDP in 2005 can be attributed to the lower educational attainment of the earthquake cohorts, which can be considered as the long-term educational cost of Tangshan Earthquake.

1. Introduction

An earthquake, as a sudden natural disaster, not only causes immeasurable losses of the social and economic development, but also has sustained and far-reaching effects on the accumulation of human capital such as education, nutrition and health, as well as the social welfare such as income and consumption (Baez, de la Fuente, & Santos, 2010).

Researchers have found that earthquakes can result in temporary reduction in income and lessen the level of consumption (Baez & Santos, 2008; Gignoux & Menéndez, 2014). Some studies have shown that earthquakes significantly reduce the individuals' educational attainment. For example, earthquakes decrease enrollment rate and increase the probability of being a child labor (Santos, 2007). Besides, through early-life malnutrition, earthquakes also have negative impacts on children's cognitive development and academic achievement (Bustelo, Arends-Kuenning, & Lucchetti, 2012). Some literatures concern the consequences of earthquakes from the aspects of physical and mental health. For instance, earthquakes evidently increase the mortality rate, raise the incidence of infectious diseases through destroying the health facilities, and cause people's depression, anxiety and other pathological behaviors (Bhatia, 2008; Chen, Lin, Tseng, & Wu, 2002; Roussos et al., 2005; Şalcıoğlu & Başoğlu, 2008). Some recent studies on intergenerational transmission of earthquakes suggest that the children whose parents suffered from earthquakes receive lower human capital (Caruso, 2015; Caruso & Miller, 2015).

In addition, some literatures pay close attention to other natural disasters such as droughts, floods, typhoons, tsunamis, etc. As can be clearly found, these disasters dramatically increase the incidence of malnutrition, deteriorate physical development and health status, hinder the academic progress, and reduce educational attainment and labor productivity (Alderman, Hoogeveen, & Rossi, 2009; Baez & Santos, 2007; Hoddinott & Kinsey, 2001; Maccini & Yang, 2009; Neelsen & Stratmann, 2011; Tan, Tan, & Zhang, 2014).

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Tangshan Earthquake was the deadliest earthquake recorded in the 20th century.[1] Tangshan, located in Hebei province, is part of the North China Plain bounded by Yanshan mountain range on the north and by the Bohai Sea on the southwest. With rich resources of coal, iron ore and oil, Tangshan has developed the coal, cement and ceramics industry rapidly, and gradually grown into a century-old heavy industrial city. Besides, Tangshan has also been an important junction of the national transportation system as well as the telecommunication network. At 3:42 am of 28 July 1976, an earthquake of magnitude 7.8 shook Tangshan with epicenter intensity XI, focal depth 23 km and longevity 12 s. Huge energy generated from the earthquake is equivalent to 400 nuclear bombs exploded in Hiroshima. It is officially estimated that Tangshan Earthquake caused 242,469 people deaths, 175,797 people seriously injured, and 4204 children orphaned. Especially for Tangshan, the corresponding numbers are respectively 148,022, 81,630, and 2652. Even 7218 households completely disappeared on Tangshan's vast land. The severely damaged or collapsed school constructions are estimated over 400,000 m^2, and the destruction rate exceeds 90%. The earthquake caused 9.1 billion loss of assets. Moreover, > 1.2 billion loss was from education, science, culture and public health, approximately 13.5% of total loss.

To the best of our knowledge, there is only one literature about the impacts of Tangshan Earthquake on human capital and social welfare. Based on the county-level panel data of 2000 Population Census, Xu (2011) used difference-in-differences (DID) model to research the long-term impacts of Tangshan Earthquake. He found that the earthquake has adverse effects on the educational outcomes. The completion rate of secondary education for counties most severely hit by the earthquake exhibits about 25% lower on average, with the sex ratio almost doubled. He also found that cohorts exposed to the earthquake do not exhibit significantly higher unemployment rate. However, Xu (2011) does not pay enough attention to the differences between urban and rural areas in the specific historical context. Because the outcome variables are macro level indicators such population size, completion rate and unemployment rate. Furthermore, lacking information on income, the research DID not analyze the causal relationship between the schooling years and the current income, based on the human capital theory.

Based on a random sample from 1% of population survey data of 2005, this article studies the impacts of Tangshan Earthquake on the educational attainment and subsequent labor market outcomes of affected cohorts. Some conclusions are as follows.

First, we employ the DID model to estimate the impact of the earthquake on the educational attainment. We treat 1961–75 birth cohorts, 1951–60 birth cohorts, and 1976–85 birth cohorts respectively as the earthquake cohorts, pre-earthquake cohorts and post-earthquake cohorts. Also, in order to eliminate the interferences of other exogenous shocks, we treat three other cities Chengde, Baoding and Handan as control group. The estimated results indicate that the educational attainment of the cohorts potentially affected by the earthquake is 14%–21% lower of a year of schooling, which can be considered as the short-term educational cost of Tangshan Earthquake.

Second, we treat the 1961–75 cohorts dummy as the instrumental variable of schooling years to simultaneously control for possible endogeneity bias. Using the local average treatment effect interpretation of instrumental variables (LATE-IV) technique, we find the rate of returns to years of schooling for the earthquake cohorts lies in 20.16%–21.79%. In order to eliminate the interference of other exogenous shocks, we treat the 1961–75 cohorts dummy and its interaction with the Tangshan dummy as instrumental variables, and find the rate of returns to years of schooling is 20.93%–27.85%.

Finally, based on the short-term educational cost and returns to education for the earthquake cohorts, we calculate the long-term educational cost. The results show that the earthquake leads 3.51%–4.77% loss of average income through the reduction of schooling years. A loss of 0.30%–0.41% of GDP in 2005 can be attributed to the lower educational attainment of the earthquake cohorts, which can be considered as the long-term educational cost of Tangshan Earthquake.

Our analysis makes several contributions to the existing literature. First, taking Tangshan Earthquake as an example, this paper provides new evidence from China about the effects of natural disasters on human capital and social welfare. Second, it is micro survey data rather than macro level data that we use to discuss the impacts of Tangshan Earthquake. Third, we apply instrumental variables to accurately identify the causal effect of education on earnings, and estimate the returns to education for the earthquake cohorts. Finally, we attempt to construct the theoretical framework of educational costs of Tangshan Earthquake, and then calculate the short-term and long-term educational cost.

The remaining paper is organized as follows: Section 2 describes our research design, sample frame and data description. Section 3 analyzes the impact of Tangshan Earthquake on educational attainment. Section 4 estimates the returns to education for the earthquake cohorts. Section 5 is the integration of Sections 3 and 4, which calculates the short-term and long-term educational cost. Section 6 reports the conclusion, and points out the limitations of our research.

2. Sample and data

1% population survey data of 2005 is currently the most canonical and reliable survey data, which is implemented by the National Bureau of Statistics. Under the method of stratified cluster probability proportional sampling, about 60,000 households are randomly selected. The database includes useful demographic information such as age, gender, minority, educational attainment, household registration status, employment status and income. In our analysis, we only use a random sample from 1% population survey data of 2005. The total original sample contains 2,585,481 individuals.

First and foremost, it is necessary to identify the birth cohorts who are potentially affected by the earthquake. Here, we reasonably

[1] In the twentieth century, earthquakes rise to > 15 million people deaths, accounting for about half of all the deaths from great natural disasters. The number of deaths from Tangshan Earthquake holds 15% of the total deaths from earthquakes. Data Source: "*Rescue, Recovery and Reconstruction During the aftermath of the Tangshan Earthquake*" authored by Yu, Su, Liu, and Liu (2003).