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Shock and roam: Migratory responses to natural disasters

Haishan Yuan [a,*], Chuanqi Zhu [b]

[a] Level 6, Colin Clark Building (39), University of Queensland, St Lucia, QLD 4072, Australia
[b] Lingnan (University) College, Sun Yat-sen University, Guangzhou, China

HIGHLIGHTS

- Use novel data on roaming cellphones to capture post-earthquake migratory responses.
- Higher emigration emerges within a few weeks after the Ludian earthquake.
- Quake-induced emigration peaks in about 14 weeks.

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ABSTRACT

Using novel data on roaming mobile phones and a synthetic control method, we find out-migration in the area affected by the 2014 Ludian earthquake in Southwest China. The induced emigration emerged within a few weeks after the earthquake and persisted for months. We find no evidence that the earthquake drew back migrants who, prior to the earthquake, had emigrated to Guangdong province, which is a manufacturing hub and the primary destination of rural migrant workers in China.

1. Introduction

Labor mobility is central to economic development. In less developed countries, migration provides an important means for households to escape from poverty and cope with negative economic shocks. In this paper, we use data on roaming mobile phones to analyze the migratory responses in the area affected by the 2014 Ludian earthquake, which was the deadliest earthquake in China since 2010.

Using a synthetic control method proposed by Abadie and Gardeazabal (2003) and Abadie et al. (2010), we construct a comparison prefecture for the prefecture affected by the earthquake. Taking advantage of the high frequency of our data, we find out-migration from the affected prefecture in the four months immediately following the earthquake. On the other hand, we find no evidence that the affected prefecture drew back existing migrants working in Guangdong province, which is a manufacturing hub and the primary destination of rural migrant workers in China.

The empirical evidence as to whether or not natural disasters induce out-migration has been mixed. Using household panel data from Indonesia, Tse (2012) finds that migration rates decrease following earthquakes, volcanic eruptions, and floods. Halliday (2006) finds that earthquakes in El Salvador caused damages to household assets and reduced the number of household members residing in North America. In contrast, we find out-migration immediately following the Ludian earthquake and no evidence of prior emigrants working in Guangdong province. Our findings are consistent with the recent finding that households in Vietnam sent household members to work in the city after their villages were hit by a severe typhoon (Gröger and Zylberberg, 2016).

* Corresponding author.
E-mail addresses: h.yuan@uq.edu.au (H. Yuan), zhuchq3@mail.sysu.edu.cn (C. Zhu).

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2. Background and data

Our primary data set consists of daily numbers of users of China Mobile roaming in and outside of Guangdong province. If a China Mobile user travels to or stays in Guangdong with a China Mobile SIM card registered outside of Guangdong and her mobile phone is turned on, her mobile phone would pin its nearby cell tower and one phone would be recorded as roaming in Guangdong for that day. Similarly, if a China Mobile user is physically located outside of Guangdong with a turned-on China Mobile SIM card registered in Guangdong, one phone would be recorded as roaming outside of Guangdong.

We obtain our data set from Guangdong subsidiary of China Mobile, which is the largest telecommunication company in China and accounts for 62% of the Chinese market as of December 2013. Because the other two major telecommunication companies have disproportionately high numbers of 3G users, who concentrate in urban areas, China Mobile's market share in rural areas is even higher. China Mobile operates through its subsidiaries in each of the 31 provinces. Each provincial subsidiary of China Mobile operates independently. They set their own prices and rate plans in their jurisdictions. Unlike in the United States or Australia, where uniform rates apply regardless of which state the mobile user is in, in China, costs for mobile calls, messages and data differ, according to whether the user is in her home province or in another. Therefore, migrants typically switch their mobile subscription to a local one within a few weeks of migrating.

Accounting for about 25% of China's imports and exports, Guangdong is by far the most popular destination for migrant workers from rural areas. In 2012, 52 millions or 20% of the country's stock migrant workers, worked in the Pearl Delta area, where Guangdong's manufacturing industries are located (National Bureau of Statistics, China, 2013). Moreover, the mobile phone penetration rate is high in China. In December 2013, the three major telecommunication companies together had 1.23 billion subscribers, equivalent to 0.91 subscribers per capita. Therefore, though we only observe migration flows as measured by mobile phones roaming in and outside of Guangdong, our data is able to capture the salient features of migration flows in China. However, because migrants switch to local subscriptions, we note that our data could only capture the short-term migration flows, but not migrant stock in Guangdong. To quantify the migratory flows captured by the number of roaming phones in Guangdong, we conduct a survey on mobile phone usage of visitors and migrants to Guangdong. We describe details of this survey in the Online Appendix A.

Our data is at the prefecture level, which is the sub-province level administrative unit. In Fig. 1, we map the average daily number of roaming mobile phone there are in Guangdong province from each prefectures, and plot the daily number of China Mobile users roaming in Guangdong from 2013 to 2015. Over the three-year period, there was an increasing number of China Mobile users roaming in Guangdong.

However, the seasonal patterns are remarkably stable. Each year, the number of mobile phones roaming in Guangdong reaches its lowest point right before the Chinese New Year, which is typically in February or late January and indicated by the orange dash line Fig. 1. Right after the Chinese New Year, the number of mobile phones roaming in Guangdong increases sharply, reaching a peak in one and a half months after Chinese New Year. After the peaks, the number of mobile phones roaming in Guangdong declines until the summer school vocation. Another wave of migration to Guangdong takes places during the summer. Indeed, the all-year peaks are around the end of July or the beginning of August. The number of roaming mobile phones returns to its pre-summer decline on September 1st, which is the first day of the school year through out China. The first days of a school year are indicated by the green dashed lines in right subplot of Fig. 1.

While the numbers of roaming phones in Guangdong reflect short-term personal and business travels, their magnitudes are unlikely to drive the seasonal patterns that are shown in Fig. 1. In Figure A.1, we also plot the daily number of Beijing and Shanghai mobile phones roaming in Guangdong. Beijing and Shanghai together have a population of 44.9 million. The drop in the number of mobiles from these two largest cities being used in Guangdong around the Chinese New Year, is modest, which suggests that the seasonal patterns shown in the right panel of Fig. 1 are driven by migrant workers from rural areas.

Only 20.7% of the 163 million migrant workers working in Chinese urban areas migrated with all members of their households in 2012. Every year, family reunions drive a massive population movement around the Chinese New Year. In Figure A.2, we plot the daily number of Guangdong-registered users of China Mobile's roaming services outside Guangdong. We have the out-roaming data from October 2013 to December 2015. Clear spikes can be seen around Chinese News Year in 2014 and 2015, and they are indicated by the orange dashed lines. During the week surrounding the Chinese New Year in 2015, 23.8 million China Mobile mobile phones roamed outside of Guangdong.

In order to quantify the migratory flows captured by the number of roaming phones in Guangdong, we need to know how long these migrant workers would retain their hometown-registered SIM cards. Therefore, we conduct a survey on mobile phone usage of visitors to Guangdong. Since migrant workers have concerns about mobile phone roaming charge, they usually switch their hometown-registered SIM cards to locally registered SIM cards in Guangdong. The main goal of this survey is to identify the SIM card switching behaviors of visitors to Guangdong, particularly the time frame of SIM card switching of migrant workers.

Since the majority of migrant workers in Guangdong province come to Guangzhou by train, we distributed our survey to those who just arrived at Guangzhou at Guangzhou railways station. We have collected 477 responses for this study from July 20th to July 26th. We focuses on the 47 newly arrived migrant workers who seek jobs in Guangdong and have not switched to a local SIM card. See Online Appendix A for more details about this survey.

3. Migratory responses to earthquake

The high frequency of the mobile phone data allows us to investigate the timing and the dynamics of out-migration following a natural disaster. On August 3rd, 2014, an earthquake with a moment magnitude of 6.1 struck Ludian county of the southwest province Yunnan. The earthquake caused 731 deaths and a damage estimated at $5 billion and affected about 1.1 million people (Guha-Sapir et al., 2016). Most of the affected population were located in Zhaotong prefecture, which has a population of about 5 million and is a low-income area in China. Ludian county is contained in Zhaotong prefecture.

We use a synthetic control method to analyze the migratory responses following the Ludian earthquake. Since proposed by Abadie and Gardeazabal (2003) and Abadie et al. (2010), the synthetic control method has proven to be a powerful tool for comparative case studies. Using a data-driven approach, the synthetic control method constructs a weighted sum of potential controls, known as the donor pool, as the synthetic control. The synthetic control method is particularly suitable for our analysis, because we have one treatment unit, namely Zhaotong prefecture, and a large donor pool, which consists of all prefectures unaffected by the Ludian earthquake.

High frequency may introduce noise in the construction of synthetic controls (Dube and Zipperer, 2015). Thus, we average