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Empirical studies on strategic interaction among municipality governments over disaster waste after the 2011 Great East Japan earthquake

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ABSTRACT

Strategic interaction among governments has become a major focus of empirical and theoretical work in public economics. NIMBY is one application of the literature. In the present paper, we apply the NIMBY model to the disposal of disaster debris after the Great East Japan Earthquake when there was substantial concern over radioactive contamination following the Fukushima Daiichi Nuclear Power Plant incident. We empirically test the strategic interaction among municipality governments. We find strong evidence of such interaction. That is, in deciding whether to accept disaster waste, the municipality governments appear to keep a close eye on other municipality governments' choices.

1. Introduction

Strategic interaction among governments has recently become a major focus of empirical and theoretical work in public economics. One branch of the literature analyzes tax competition where governments levy taxes on a mobile tax base. Theories of interjurisdictional tax competition date back at least to Zodrow and Miezkowski (1986), who examine the race to the bottom or self-defeating nature of the competition with Nash equilibrium tax rates being inefficiently low. Since then, tax competition models have developed in various directions: see Wilson (1999) for an extensive survey. Several empirical studies have shown ample evidence for spatial interaction (Buettner, 2003). A related literature focuses on welfare competition. Saavedra (2000), for instance, tests empirically for strategic behavior among the states using the cash support program Aid to Families with Dependent Children.

In parallel, interjurisdictional regulatory competition has evolved, in which the terms of local public goods and taxes are replaced by environmental quality and regulation. It has been addressed that environmental regulation and taxes may turn out to be too high when governments interact over NIMBY activities. NIMBY is the acronym for "Not In My Back Yard," referring to major community resistance to the establishment of facilities generating social benefits but bearing some regional cost in both pecuniary and nonpecuniary forms. Examples are abundant including sewage treatment plants, nuclear power plants, military bases, group homes for the mentally disabled, waste disposal facilities, landfills, prisons, and so on.

In economics terminology, a NIMBY facility yields a net social benefit and thus should be supplied from an efficiency perspective, but it involves a net cost to the locating community, which then escalates oppositional activities against the facility. That is, the distribution of benefits and costs is uneven. The regionally incurred cost may not be certain but may rather be the risk of a hazardous incident such as the leakage of contaminant materials in the case of disposal facilities. One can describe NIMBY as community ego against social well-being or instead as a plausible political right to defend the community from any harm. Under either interpretation, NIMBY involves a situation in which social welfare conflicts with regional welfare.

NIMBY leads to intergovernmental interaction. In responding to their own residents' concerns, each local government may deliberately undertake preventive actions such as intensifying regulations and/or raising fees or taxes on the NIMBY facility. However, such actions will trigger counteractions by other local governments. As opposed to the race-to-the-bottom nature of tax compe-

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tition, NIMBY is often considered to be a race to the top in associated regulations and taxes.

As an example of NIMBY, Levinson (1999) considers hazardous waste disposal taxes in the US. His focus is on how state taxes on hazardous waste disposal—specifically the Toxics Release Inventory—affect intrastate waste shipment. It is shown that taxes matter and are empirically significant in decreasing shipments of waste to high-tax states. Levinson does not analyze the strategic interaction among states in setting their hazardous waste taxes, however.

In the present paper, we apply a NIMBY model to the disposal of disaster debris after the Great East Japan Earthquake and empirically test strategic interaction among municipality governments. The Great East Japan Earthquake occurred near the northeast coast of the Tohoku region in Japan on March 11, 2011. It recorded a magnitude of 9.0 with the number of dead and missing totaling 15 799 and 4041, respectively. The economic damage is estimated to be USD 210 billion (¥16 800 billion) or about 3% of annual GDP. The earthquake was followed by a massive tsunami that destroyed coastal communities. The tsunami also impacted Fukushima Daiichi Nuclear Power Plant, resulting in explosions because of the loss of power and the release of 630 000 – 770 000 terabecquerels of radiation.

The earthquake and subsequent tsunami generated massive volumes of debris or disaster waste such as the ruins of homes, damaged buildings, automobiles, and ships. The disaster waste could not be disposed of solely in the facilities of municipalities in the disaster areas. For that reason, the Japanese government asked all local governments and related groups outside the disaster areas to accept and manage the debris from the disaster areas (Ministry of Environment, 2011). However, this invited fierce opposition against acceptance among local residents because they were concerned that the disaster waste may be contaminated by radiation from the Fukushima Daiichi Nuclear Power Plant. Thus, disaster waste disposal is a NIMBY type of policy as illustrated in the next section.

There is a body of theoretical and empirical research concerned with strategic interaction among local governments in this literature. Examples include expenditure spillovers (e.g., Case et al., 1993), yardstick competition (Besley and Case, 1995), tax competition (e.g., Buettner, 2003; Devereux et al., 2008), peer effects (Hanushek et al., 2003) and Sacredote, 2001), and environmental regulations. Brueckner (2003) provides an extensive overview of "conceptual issues" associated with strategic interaction.

Spatial econometrics has developed for the empirical analysis to identify strategic interactions. Typically, spatial econometric methodology specifies interdependence among localities' decision making using a spatial lag term or a weighted sum of other localities' decisions, and unobserved interactions using a spatial error dependence. It is well known that a spatial autoregressive model with spatial error correlation (SARAR) secures consistent estimation by incorporating both spatial autocorrelation and spatial dependence in errors simultaneously (e.g., Brueckner, 2003). The current paper adopts the SARAR model to deal with the coexistence of spatial autocorrelation and spatial error dependence, after checking for the presence of both spatial correlations using valid statistical tests. We also attempt to deal with the identification problems in the spatial econometrics in terms of consistent estimation of theoretical models involving strategic interaction.

This paper is organized as follows. Section 2 describes the disaster waste disposal after the Great East Japan Earthquake. Section 3 provides a heuristic illustration of the theory, including a comparison of *Kizuna* and NIMBY. In Section 4, we turn to our empirical strategy using spatial econometrics. Section 5 provides a description of the data. Our empirical findings are presented and discussed in Section 6. Section 7 concludes.

2. Background

The Japanese Ministry of the Environment estimated total earthquake and tsunami debris to be 20 million tons as of May 21, 2012. This exceeds the 15 million tons from the Great Hanshin–Awaji (Kobe) Earthquake in 1995. The affected areas in 2012 were overwhelmed by this volume of debris. Indeed, the amount of debris in Iwate Prefecture was 11 times greater than the amount that the area usually generates in a normal year, and in Miyagi, it was 19 times greater (UNEP, 2012).

The debris has become a large impediment in the disaster areas to returning residents' lives and economic activity to normal. It also raised public concern about health because the debris contains a variety of substances including hazardous chemicals. It is necessary to dispose of this debris quickly. The Japanese government drew up a plan to complete the disposal of the debris by the end of March 2014. However, achieving this was extremely difficult using only the disposal facilities in the disaster areas. As of summer 2011, Iwate and Miyagi Prefectures requested that 570 000 tons and 2.94 million tons, respectively, be disposed outside of their areas. In Japan, most disposal facilities are owned and managed by municipality-level governments or their association. The association for regional affairs (*Ichibu-jimu-kumiai*) is organized to collaborate across neighboring areas in matters such as waste disposal, sewer and water management, and firefighting. The Japanese Ministry of the Environment asked all municipality governments in Japan to accept and dispose of debris from the disaster area.

The central government also implemented emergency legal action to manage disaster waste. In August 2011, Japan enacted the comprehensive disaster waste management law "Special Measures Act on Disaster Waste Management" (Law No. 99 of 2011). This law enabled the central government to request local governments outside the disaster area to accept disaster waste and to manage it at the central government's expense. On March 21, 2012, the central government used this provision, with the Prime Minister sending letters to request prefectures and the largest cities that had not accepted disaster waste to accept and manage it. On June 29, 2012, the Minister of the Environment sent a notice asking for the cooperation of local governments as well. As of January 2014, 91 municipalities and their associated groups had accepted and managed disaster waste totaling 654 000 tons, with 332 000 tons from Iwate and 322 000 tons from Miyagi, respectively.

A complication of the disaster waste disposal occurred because of concern about radioactive contamination from the Fukushima Daiichi Nuclear Power Plant. Many residents outside the affected area were concerned that the waste may have a higher radioactive level than normal and thus seriously damage their health. In addition, there has been some concern over "damage by rumor" where the disaster waste may adversely affect the reputation of regions producing goods such as agricultural and marine products. Damage by rumor arises even when the residents of accepting regions are certain about the safety of the debris but consumers (outside the region) purchasing the products in question are not. Indeed, agricultural and marine products in the Tohoku area have suffered severe reputational damage.

Radiation contamination concern about the disaster waste has made it difficult to manage the disposal, resulting in delays in waste management. The central government has undertaken some measures to deal with these concerns. For instance, currently, the disaster waste cannot be disposed of or recycled if its radiation level exceeds the clearance level of 10 μSv/yr (micro Roentgen equivalent man per year). This level is an order of magnitude lower than the no-action level for radiation in sewage sludge and is regarded as low by experts (Shibata et al., 2012). The debris in Fukushima where the crippled nuclear complex is located will be disposed of within the prefecture. Nevertheless, there has been