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The Change in Industrial Structure of Fukushima before and after the Nuclear Accident: 10 Years Later

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Summary

This paper investigates the regional political economy of the Fukushima’s nuclear accident evacuation zones. I firstly review a budgetary constraint between evacuation and decontamination. Secondly, it is argued that the Tokyo Electric Power Company (TEPCO) and the central and regional government are seeking to work within the state-level and firm-level budgetary constraints. The final section demonstrates the change of industrial structure of Fukushima before and after 3.11 and examines what the policy, that is used as a fiscally cheaper and politically easier alternative to the larger-scale evacuation, implies to the regional economies of Fukushima.

Keywords: Nuclear Accident, Fukushima, Budgetary Constraints, Evacuation, Decontamination, Regional Economy

1. Introduction

The Great East Japan earthquake in 2011 struck the northern periphery rural Tohoku region severely, and the subsequent tsunami devastated the span of over 500 km of the Pacific coast of the region. The numbers of deaths and of persons affected by the earthquake and the tsunami were still comparatively smaller than those from other historical earthquakes/tsunami in the world such as Sumatra offshore earthquake of 2004, Sichuan earthquake of 2008, or Haiti earthquake of 2011 (Fujimoto, 2017). Nevertheless, the Great East Japan earthquake disaster recorded the one of the greatest economic losses in history, followed by the Hanshin-Awaji Earthquake in 1995, which hit heavily urbanized areas of the country. What sets the Great East Japan earthquake disaster apart from many other disasters is the nuclear accident at the Fukushima Daiichi (No. 1) nuclear power plant of the Tokyo Electric Power Company (TEPCO). A series of hydrogen explosions of the reactors resulted in the release of radioactive materials in extensive areas in eastern Japan, affecting the most significantly the eastern part of Fukushima prefecture and its adjacent areas. Radioactive contamination does not easily fit in conventional categories of natural disasters (Guha-Sapir et al., 2012). In particular, where, who and what were affected by radioactive contamination are not easily determined by conventional guidelines for natural disasters; yet, such information is essential in calculating economic damages and appropriate compensation. Consequently, the determination of the extent and magnitude of radioactive contamination has become a highly complex and political charged issue in post 3.11 Japan.
After the nuclear accident, 8,000 monitoring posts have been set up throughout East Japan to monitor the spread of radioactive material in terms of air dose which helps determine the areas and extent of evacuation. As a result of the monitor, with using 20 mSV/year as the threshold radiation level, the national Cabinet Office ordered persons who lived within 20 km from the plant and other “hotspots” in several small towns and villages, painted in orange and pink in the figure 1, to leave their homes soon after the nuclear accident. Residents of these areas became entitled to receive financial compensations from TEPCO (figure 1).

However, the cabinet’s practice is problematic at least on two aspects. Firstly, the current monitoring systems, with a 2 km grid, provides far too sparse areal coverage, given that high contamination can occur at much smaller resolutions. Secondly, the current safety limit of 20 mSV/year is arguably too high as the threshold for evacuation. If we apply the Chernobyl standard to Fukushima, two-thirds of Fukushima prefecture, including much of Hamadori (costal area) and Nakadori (central area), would be authorized as evacuation zones. Yet, these coastal and central areas, which have high radioactivity rates, have been excluded from the authorized evacuation zone.

This paper investigates the regional political economy of the Fukushima’s nuclear accident evacuation zones. I first review a budgetary constraint between evacuation and decontamination. Secondly, it will be argued that TEPCO and the central and regional government are seeking to work within the state-level budgetary constraints. The final section demonstrates the change of industrial structure of Fukushima before and after 3.11 and examines what the policy, that is used as a fiscally cheaper and politically easier alternative to the larger-scale evacuation, implies to the regional economies of Fukushima.

2. Budgetary Constraints of Evacuation and Decontamination Common Agricultural Policy

Fiscal budgetary resources tend to be scarce. States with reconstruction expenditures must make decisions on budgetary allocations. Scarce national resources force the state to make choices and trade-offs while allocating for expenditure. When making allocations under scarce budgets, the state is inherently allocating public expenditures for one purpose and has no alternative. On the supposition that there is a trade-off between evacuation and decontamination with regard to national budgetary expenditures for a nuclear disaster, I compare the reconstruction budgetary allocation of the former Soviet Union to that of Japan. As shown in Figure 2, the slope of the government’s budget curve will vary as a direct result of how it allocates the evacuation budget with a change in decontamination. To find the least-cost method of budgetary allocation for a nuclear disaster, two lines could be
drawn on the assumption of resettlement for both the Fukushima and Chernobyl accidents. This figure indicates the relationship between two public good and services relative to the opportunity costs, which define the value of the each good and service relative to one another. In the figure provided, in Japan a quantity of ten for public good D (decontamination) is identical in economic value to the quantity two for public good E (evacuation).

The line is somewhat sharper than 45°. This is because the price of D is slightly less than the price of E. The steep slope of the budgetary-constraint curve in Japan indicates that the economic value for evacuation is more expensive than it is for decontamination. It can be said that the arithmetic value of the slope of the budgetary-constraint line must be equal to the ratio of the price of E to that of D— in this case price of E divided by price of D is 5. The substitution ratio is less than one because of the higher economic estimation in E and the lower evaluation of D. In Belarus and Ukraine, as the former U.S.S.R., a quantity of two for “public good D” is identical in economic value as a quantity of ten for “public good E”. The line is slightly flatter than 45° because the price of D is somewhat higher than the price of E. The slow slope of the budgetary-constraint curve of the former U.S.S.R. indicates that the economic value for evacuation is lower than that of decontamination. It can be said that the arithmetic value of the slope of the budgetary constraint line must equal the ratio of the price of E to that of D—in this case price of E divided by price of D is 0.2. The substitution ratio is greater than one because of the higher economic estimation in D and the lower economic value in E. The high price of evacuation in Japan is connected to the question as to why the evacuation cost is higher than decontamination (figure 2).

Considering these costs per capita about the Fukushima’s nuclear accident, the experiential formula and figure for the budget constraint line are described in figure 3. After the decimal is discarded, the substitution ratio of decontamination to evacuation is found to be 13. The actual line is somewhat greater than 45° since the price of decontamination is fairly less than the price of evacuation. The steep slope of the budgetary constraint curve in Japan indicates that the economic value for evacuation is more expensive than it is for decontamination. Thus, it can be concluded that the mathematics value of the slope of the budget constraint line must equal the ratio of the price of x to that of y. In this case, the price of evacuation/price of decontamination equals 13. The substitution ratio is more than one because of the higher economic estimation of evacuation and the lower assessment of decontamination. Under the condition of the Fukushima accident’s budget constraint line, the government can bear the damages for the accidents as 111,000 evacuees for evacuation and 1,443,000 residents for decontamination at the maximum (figure 3).

In short summary, the formally declared exclusion zone has been determined as a result of the national government budgetary constraints calculated from actual budget expenditure shown in figure 3. Because Japan’s national economy cannot withstand any additional burden for the new evacuation zone as a planned regional economic area, it will never be clear that real areas constitute polluted zones. This is why the MOE (the Ministry of Environment) and the NRA (the Nuclear Regulation Agency) continue to make on the spot investigations on the radioactivity diffusion in central and coastal Fukushima. The high price of an evacuation in Japan is connected to the high disposable income, the guarantee of the right to live in the same place as birth and raised-up place, and the prospect of compensation for lost profits. They would be estimated as astronomical and a huge burden on the...
national and global economies. The actual budget expenditure is shown in figure 4 as a result of cost minimization principle by the government and electricity power company (figure 4).

![Budget Expenditure for the Fukushima Accident (2011-19)](Image)

**Figure 4** The budget expenditure for the Fukushima accident (2011-19)


### 3. Prefectural Industrial Structure of Fukushima

In place of more extensive compulsory evacuation areas, the governmental-industrial complex in post 3.11 Japan has promoted what I call a “decontamination-intensive reconstruction policy”. The decontamination-intensive reconstruction policy means that large portions of reconstruction budget of the central and local governments are spent on decontamination projects, which are typically contracted to general construction companies. In essence, this policy preserves the structure of orthodox public investment in projects such as dams, roads and ports (Fujimoto, 2017), which has dominated the political economic system of postwar Japan, which is often referred to as developmentalism.

It is necessary to understand the changes in the prefectural industrial structure in order to reveal the impact of decontamination-project on the regional economy of the Fukushima prefecture. As shown in figure 5 and 6, the industrial structure of Fukushima, as indicated by the share of each industry’s GDP, shows a high dependence on three economic sectors: utilities (including electricity), construction, and government. For example, in 2006, when it was in the period of structural reform of the Japanese economy by the Koizumi administration, the utility industry accounted for 8.0% of total prefectural GDP. In 2010, when it was just before the nuclear accident, the utility industry accounted for 8.8%, which is considerably higher than the average of all prefectures, 2.5%, in the same year. This high share reflects the fact that Fukushima had two nuclear plants, Fukushima Daichi (six reactors) and Daini (four reactors) along the Pacific Ocean. However, in 2012 immediately after the suspended operation of the plants caused by the accident, the share dropped sharply into 4.7% and in spite of the prefectural economic policy as one of the symbols of ‘reconstruction and recovery’, that introduces renewable energy such as solar, wind, hydroelectric, geothermal, biomass and ocean into the Fukushima prefectural land, the share of utilities in 2017 was not more than 6.0% (Figure 5 and 6).

The share of construction industry has been also higher in Fukushima than in the nation as a whole. In Japan, construction industry is conventionally divided into two subsectors: civil engineering and architecture/building. The construction industry’s share of prefectural GDP in Fukushima accounted for 7.0% in 2001; however, it decreased to 4.8% by 2010. From the end of World War II until just before the Koizumi administration (2001-06), an enormous amount of investment from the central government in the form of infrastructure construction had been poured into low-income and peripheral regions of the country such as Tohoku, Hokkaido, Hokuriku, and South Kyushu. Fuku-
shima Prefecture with relatively poor locational conditions for propulsive industries (e.g., petrochemical, iron-and-steel, and automobile industries) in the 1960s and 1970s was no exception. Many unprofitable sectors such as the Tohoku Shinkansen, small- and middle-sized seaports, airports, and some minor highways were all built by public investment as part of massive fiscal transfer policies aiming for “more balanced national land development.

This dominant postwar national land policy orientation became challenged during the Koizumi administration in the early 2000s under the name of structural reform (Fujimoto, 2014). The Koizumi structural reform resulted in sudden reductions in public investments. In other words, subsidies from the central government to rural prefectures were cut drastically. This reform had a considerable impact on the construction industry nationwide. The decline in the GDP share of the construction industry in Fukushima in the early 2000s reflects this national trend. Nevertheless, there is another factor that is specific to Fukushima that contributed to this decline. In 2006, the governor of Fukushima Prefecture was arrested by the Tokyo District Public Prosecutors Office for accepting a bribe from a construction company. Consequently, the prefectural government reformed its auction system for local public projects, and installed a new competitive bidding system for all prefectural contract works in 2007. This change also contributed to the decline in the output of Fukushima’s construction industry after 2009.

The downward trend of declining relative importance of the construction industry reversed after the Great East Japan disaster in 2011. Its GDP share rose back to 8.0% in 2011 and 9.5% in 2012, doubling its share from 2010. The upward trend was observed from 8.0% in 2011 until 12.0% in 2016. In 2017, the upward trend reversed after the reduction in governmental budget for reconstruction economic policy totally by the Reconstruction Agency, nevertheless, the industry share still accounted for 10.5%.

The government sector is also important in Fukushima as a tool of income redistribution policy at national land level. The share of government services was 5.5% in 2006 and it was rapidly risen as 6.9% in 2011. The share of the services industry continues to keep high rate until 2017 as 7.4%. On the other hand, the share of the electric power industry declined further to 3.8% in 2011 and 4.4% in 2012, less than half of the share in 2010. It is important to realize, however, that the revival of the construction industry does not necessarily reflect the rebuilding of the infrastructure destroyed by the earthquake and tsunami. Actual additional value production in the industry was largely occupied with the decontamination project. This project led the multiplier effect in the regional economy and the share of employment in construction industry was expanding from 2011 to 2017 and the rate became 12.0% in 2017 (figure 7 and 8).

![Image](https://example.com/image.png)

(Unit: percentage)

**Figure 5** Industrial’s share in the GDP of Fukushima Prefecture (2006 – 2017)

Figure 6: Comparison of Industry’s share in GDP (2016)

(Unit: percentage)


Figure 7: Industrial’s share in the employment population of Fukushima Prefecture (2006 – 2017)

(Unit: percentage)

4. Conclusion

With the above substitution ratio analysis, the author clarified that the decontamination project conducted in central and coastal Fukushima as a substitute for evacuation was because of the economic factors that prevented the government and TEPCO from providing astronomical compensation payouts to those living without the right to evacuate from Fukushima. As a result of containing the compensation fees within the 20 km radius, the national government and electricity power company have maintained their business activities as normal. The effect of this policy was reflected by the re-expansion of construction industry in terms of the GDP and employment of Fukushima. In addition, it was shown that the high market value of an evacuation in Japan was connected to three factors: (1) the expensive disposable income per capita; (2) the guarantee of the right to live by fundamental human rights and (3) the prospect of compensation for lost profits related to lifetime expected wages. Furthermore, foreign loans and aid to the Japanese government in terms of economic value are like one drop in the ocean since the size of Japan’s national economy is the 3rd largest in the world.

5. Literature

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