



The effect of the Fukushima nuclear accident on stock prices of electric power utilities in Japan

Shingo Kawashima ^a, Fumiko Takeda ^{b,*}

^a Department of Systems Innovation, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

^b Department of Technology Management for Innovation, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

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ABSTRACT

The purpose of this study is to investigate the effect of the accident at the Fukushima Daiichi nuclear power station, which is owned by Tokyo Electric Power Co. (TEPCO), on the stock prices of the other electric power utilities in Japan. Because the other utilities were not directly damaged by the Fukushima nuclear accident, their stock price responses should reflect the change in investor perceptions on risk and return associated with nuclear power generation. Our first finding is that the stock prices of utilities that own nuclear power plants declined more sharply after the accident than did the stock prices of other electric power utilities. In contrast, investors did not seem to care about the risk that may arise from the use of the same type of nuclear power reactors as those at the Fukushima Daiichi station. We also observe an increase of both systematic and total risks in the post-Fukushima period, indicating that negative market reactions are not merely caused by one-time losses but by structural changes in society and regulation that could increase the costs of operating a nuclear power plant.

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1. Introduction

On March 11, 2011, following the East Japan great earthquake and tsunami, failure occurred in three of the six nuclear reactors at the Fukushima Daiichi nuclear power station owned by Tokyo Electric Power Co. (TEPCO). Based on the evidence of partial nuclear meltdowns in these nuclear reactors, on April 12, the Nuclear and Industrial Safety Agency (NISA) raised the crisis level of the Fukushima nuclear accident to 7 based on the International Nuclear Event Scale (INES), a level that had previously only been applied to the Chernobyl accident in the former Soviet Union in 1986. Following the event at the Fukushima Daiichi station, the planned construction of several nuclear power plants was stopped; safety rules were tightened; the operation of several existing nuclear power plants was suspended due to regular or emergent inspections; and the resumption of operation of the inspected nuclear plants was postponed. The social movements to halt nuclear power plants have gained strength and continue.

From the viewpoint of investors, stocks of electric power utilities have long been regarded as defensive stocks that are not affected by economic conditions and thus provide stable dividends. However, recent changes in the attitudes of the public and of the industry

regulators suggest increased uncertainty surrounding future cash flows of these utilities. The purpose of this study is to investigate the effect of the accident at the Fukushima Daiichi nuclear power station on the stock prices of electric power utilities in Japan. Specifically, we estimate the cumulative abnormal returns (CARs) by using the market model based on the pre-Fukushima period estimation windows.

Earlier studies examining stock price reactions to nuclear accidents focus on the previous two big nuclear accidents, at Three Mile Island (TMI) in 1979 and Chernobyl in 1986.¹ These studies report that in each case, stock prices of utility securities declined sharply after the accident, particularly for firms with a major commitment to nuclear power generation (Bowen et al., 1983; Fields and Janjigian, 1989; Hill and Schneeweis, 1983; Karla et al., 1993). Currently, to the best of our knowledge, there are four studies that investigate the effect of the Fukushima nuclear accident on stock prices (Betzer et al., 2011; Ferstl et al., 2012; Lopatta and Kaspereit, 2012;² Mama and Bassen, 2011). Most of them report significantly negative CARs for Japanese electric utility stocks during both the first couple of days and the subsequent 20–30 days after the accident, though contagion effects depend on countries and utility types.

* Corresponding author. Tel./fax: +81 3 5481 1191.

E-mail addresses: shingokawashima@gmail.com (S. Kawashima), takeda@tmi.t.u-tokyo.ac.jp (F. Takeda).

¹ A summary of prior/contemporary studies and their comparable results are presented in Appendix 1.

² Precisely speaking, Lopatta and Kaspereit (2012) appeared online after the earlier version of our paper.

Ferstl et al. (2012) examine the market reaction of 29 nuclear utility and 17 alternative energy stocks in France, Germany, Japan, and the USA. They report significantly negative CARs for Japanese nuclear utilities during both the one-week and four-week event windows. In addition, French and German nuclear utility and alternative energy stocks exhibit significantly negative CARs for the one-week window but no significant CARs for the four-week window. The U.S. stocks do not react significantly for either windows.

Mama and Bassen (2011) investigate stock price reactions of 57 conventional utilities and 54 alternative utilities in Japan and European countries. They also find significantly negative CARs for Japanese nuclear utility firms for both short and long event windows. For the first few days after the accident, European conventional utility stocks exhibit significantly negative responses, while alternative utility stocks show significantly positive responses. However, the significant responses did not last long, except for alternative utility stocks in Germany and France. They also report an increase (decrease) in the systematic risk of conventional (alternative) utilities after the accident. For Japan an increase in both total and idiosyncratic risks is observed, while for Europe a decrease in the idiosyncratic risk of conventional utilities is documented.

Betzer et al. (2011) focus more on the impact of the German change in nuclear policy after the Fukushima accident. They report a negative (positive) reaction for German nuclear (renewable) energy utilities during the 20-days after the policy change. However, this reaction is not observed in other European countries or the USA. More recently, Lopatta and Kaspereit (2012) examine market reactions of 52 nuclear utilities and 4 others in 14 countries. They find that the whole sample exhibits significantly negative responses, while the sample excluding utilities directly affected by the earthquake and tsunami does not generate significant responses. In addition, they show that firms' reliance on nuclear power is negatively associated with stock prices, and that firms' commitment to renewable energies did not serve as an instrument of diversification.

Our study is in line with others' research but has the following two differences. First, other contemporary studies concentrate more on the contagion effects to other countries and do not examine the difference in market responses of Japanese electric utility stocks in detail. Most of the contemporary studies focus on the difference between nuclear/conventional utility stocks and alternative/renewable utility stocks in other markets. Instead, we examine how other factors, such as the degree of dependence on nuclear power generation and the use of the similar types of nuclear power reactors to those at the Fukushima Daiichi nuclear power station, affect differences in market responses in Japan. Through these trials, we report a different result from prior studies.

Second, our dealing with the Japanese data is likely to avoid potential problems that other studies may have. For instance, Ferstl et al. (2012) and Mama and Bassen (2011) do not separate electric power utilities directly hit by the earthquake and tsunami from their sample,³ and thus their estimated impact of the Fukushima accident may have been largely affected by these utilities. In our study, we exclude these two victims of the natural disaster from our sub-samples. In addition, Mama and Bassen (2011) employ Nikkei 225 as the Japanese market index, which is the simple average of the stock prices of only 225 firms listed on the first section of the Tokyo Stock Exchange (TSE) and thus is not usually used in event studies.⁴

In the present study, we report the following four main findings. First, the stock prices of the firm hit by the earthquake declined more

³ Mama and Bassen (2011) include Tohoku Electric Power Co. in their ex-TEPCO sample. Likewise, Ferstl et al. (2012) include both TEPCO and Tohoku Electric Power Co.

⁴ Because the Nikkei 225 is the simple average of only 225 companies, it can be affected by large changes in the stock prices of specific industries. Thus, most event studies employ TOPIX (Tokyo Stock Price Index), which is the market capitalization of all (floating after 2005) stocks listed on the first section of the TSE.

sharply than did those of the other electric power utilities. Second, the stock prices of utilities that own nuclear power plants declined more sharply than did those of electric power utilities without nuclear power plants. Third, shareholders did not seem to care about whether electric power utilities own nuclear power reactors similar to those at the Fukushima Daiichi station. In particular, market reactions were not different between utilities with old nuclear power reactors built in the 1970s and those without them, or between utilities with the Mark 1 nuclear reactor container and those without it. This result is different from that provided by Bowen et al. (1983), which show that firms with nuclear power plants built by Babcock and Wilcox (BW) made the difference in market responses. Lastly, we observe an increase of both systematic and total risks in the post-accident period, indicating that negative market reactions are not merely caused by one-time losses but by structural changes in society and regulation that could increase the costs of operating a nuclear power plant.

The rest of this article is organized as follows. Section 2 provides background information and hypotheses development. Section 3 describes our methodology and data. Section 4 discusses empirical results. Concluding remarks are provided in Section 5.

2. Background information and hypotheses development

Japan's electric power utilities are regulated by the Electricity Business Act of 1964. Article 2 (1) of the Act classifies the electricity business into four categories: general electricity business, wholesale electricity business, specified electricity business, and specified-scale electricity utility. General electricity business is conducted by ten local monopolies, each of which supplies electricity to meet the general demand in a local area. These companies are named after the local area where they are operating, i.e., Tokyo, Tohoku, Chubu, Kansai, Chugoku, Hokuriku, Shikoku, Kyushu, Hokkaido, and Okinawa. All of them are public companies. These companies provide users with more than 99% of the electricity used in Japan (Yamaguchi, 2007).

Wholesale electricity business is conducted by two utilities, namely, J-Power and the Japan Atomic Power Company (JAPC). While J-Power is a public company, JAPC is not. These companies supply local monopolies with electricity to be used for their general electricity business. Specified electricity business is conducted by five utilities, each of which supplies electricity to meet the demand in a specified area. Specified-scale electricity business is conducted by 35 utilities, each of which supplies electricity to meet a large-scale demand from electricity users. Both specified electricity utilities and specified-scale electricity utilities are minor providers of electricity and thus are excluded from our research focus.

As will be further explained in Section 3, our sample consists of ten local monopolies that supply general electricity business and J-Power, one of the wholesale electricity utilities. All of these companies are listed on the first section of the Tokyo Stock Exchange and supply more than 99% of the electricity used in Japan. Among eleven sample firms, only Okinawa Electric Power Co. (OEPC) and J-Power do not operate nuclear power plants, though J-Power has a nuclear power plant under construction. According to the Agency for Natural Resources and Energy, nuclear power generation supplied 32% of the electricity generated in Japan in fiscal year 2010.

On March 11, 2011, following the East Japan great earthquake and tsunami, failure occurred in three of the six nuclear reactors at the Fukushima Daiichi nuclear power station owned by TEPCO. The earthquake cut the external power supply to the nuclear power plants, while the tsunami neutralized diesel generators that were meant to be available for emergencies. The loss of power crippled the reactor's coolant, resulting in explosions, radiant leaks, and meltdowns. On the basis of these developments, on April 12, the NISA raised the crisis level of the Fukushima nuclear accident to 7, a level that had only been applied previously to the Chernobyl accident in the former Soviet Union in 1986.

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