Effect of the Fukushima accident on saving electricity: The case of the Japanese Professional Baseball League

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EIJI YAMAMURA

Seinan Gakuin University

Address: Department of Economics, Seinan Gakuin University, 6-2-92 Sawara-ku, Nishijin, Fukuoka 814-8511, Japan

E-mail address: yamaei@seinan-gu.ac.jp

ABSTRACT

This paper investigates whether and the extent to which the Fukushima nuclear accident 2011 affected human behavior based on a natural experiment with the Japanese Professional Baseball League. Comparing the duration of games in the 2010 and 2011 seasons reveals the following. (1) The duration of a game in the 2011 season was shorter than that in 2010, especially during the summer when Japan was experiencing an electricity shortage. (2) The duration of a game played on a holiday is longer than that played on a workday in 2011, whereas there is no difference between a holiday and workday game in 2010. (3) The greater the distance between Fukushima and the location the game is played, the longer the duration of the game in 2011. This was not observed in 2010. These findings imply that a nuclear accident increased the incentive of baseball players to engage in successful collective action to save electricity by decreasing the duration of a game, especially when the probability of an electricity shortage was high.

Keywords: Nuclear accident; collective action; duration of a game; saving electricity; Japanese Professional Baseball League

JEL classification: L83; N75; D78.

1. Introduction

The devastating Fukushima nuclear accident on March 11, 2011, which followed a massive earthquake and tsunami, has had a tremendous effect on social and economic conditions in Japan. The accident increased the possibility of an electricity shortage in Tokyo because the Fukushima nuclear plants supplied electricity to the Tokyo region. Thus, there was a high possibility of a major power failure in Tokyo following the disasters. If a major power failure was to occur in Tokyo at that time, significant confusion would have ensued throughout the country. To avoid such a situation, parts of Tokyo had scheduled blackouts to save power immediately after the accident. On April 28, 2011, the government announced a plan to ask businesses and households in the east and northeast to cut their summer peak-time power use by 15 percent to offset the shortages caused by the damaged and suspended nuclear power plants (Japan Times 2012 p. 7).

It is interesting to explore whether such an unprecedented situation changed people's behavior in the various facets of their daily lives. Larger enterprises were also urged to reduce their electricity usage. However, the price of electricity remained fixed after the Fukushima accident in Japan, and the market mechanism did not cause individuals to save electricity. In addition, individuals were requested but not obliged to save electricity—saving electricity was not enforced by any third party. In such a situation, if people are individualistic, they will not change their lifestyle to save electricity. This raised a difficult problem in Japan. In reality, however, Japan did not experience any power shortages or major power failures in 2011. This might be due, in part, to the countermeasures taken by companies to meet the emergency situation. For instance, according to surveys conducted by the business lobby Keidanren, some companies decided to shift their working hours from weekdays to weekends or from day to night to reduce peak demand (Japan Times 2012 p. 21). Few studies have quantitatively analyzed the behavior taken by companies and people in Japan to avoid power shortages and their reasons for doing so.[1]

Looking at the sports industry, a rich dataset is available to analyze the behavior of players during the period following the disasters. More specifically, focusing on the Japan Professional Baseball League (JPBL), the accident occurred just before the first day of the 2011 season, which was scheduled to start on March 25, 2011. The JPBL at that time consisted of the Central League (CL) and the Pacific League (PL). As a consequence of the accident and the extreme conditions the first game was not held. The PL was directly affected by the disasters because one of the PL teams, the Tohoku Rakuten Eagles, was based in Sendai, a city in one of the disaster-stricken areas. Understandably, the first day of the PL was immediately postponed to April 12, 2011. In contrast, in the case of the CL, serious conflict and controversy ensued between players and management concerning the start of the 2011 season. The players' union insisted that the first day should be delayed because it was not appropriate to start the season in light of the situation in Japan. In contrast, the CL manager wanted to start the

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[1] Recent research concerning the Great East Japan Earthquake have attempted to explore how the disaster affected the Japanese economy (Hayashi 2012), for instance, by studying exports and corporate behavior (Ando and Kimura 2012). Sawada (2012) investigated the implication of the disasters that hit Japan prior to 2012 to reconstruct the Great East Japan Earthquake. Based on Japanese data during the period 1975–2007, Iwata et al. (2012) suggested that public mitigation rather than private mitigation contributes to the reduction of the total damage from natural disasters in Japan. Yamamura (2010) also used data from Japan and found that the interaction between social capital and the experience of a disaster plays a significant role in the mitigation of damage caused by natural disasters. A number of studies have also used cross-country data to assess the impact of natural disasters on GDP (Skidmore and Toya, 2002; Toya and Skidmore, 2007).

season on March 25. Eventually, the first day of the CL was changed to April 12 and the CL and PL started their seasons on the same day.

A large amount of electricity is consumed in a baseball game, requiring energy for electronic scoreboards, lighting if the game is played at night, and air-condition for games held in enclosed dome stadiums. Hence, like other industries, the reduced electricity supply after the Fukushima accident put tremendous pressure on the JPBL to save electricity. In addition, as reflected in the attitude of the players' union regarding the first day of the 2011 season, Japan's nuclear disaster, which followed the earthquake and tsunami, is believed to have affected people' perceptions and so induced people to take collective action to cope with the emergency situation.[2] The consumption of electricity increases as the duration of a game becomes longer, and players can thus contribute to electricity saving by reducing the duration of their game. The evaluation of baseball players' performances is based on their efforts to win the game. Thus, the duration of a game does not influence the evaluation of players, although in 2011 a reduction in game duration was important to save electricity and for the sake of Japanese society. Players have no incentive to reduce the duration of a game if they are individualistic and behave to improve their performance to win the game. In this situation, the collective action of players is important for the benefit of Japanese society. As reported in the media, Japanese people continued to follow official instructions and avoided chaos even immediately after the Great East Japan disaster (Ono 2012). This suggests that social norms or social capital lead people to avoid individualistic behavior and to engage in collective action for the sake of society

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[2] As a consequence of the Fukushima nuclear accident, people's views regarding the security of nuclear energy has changed, not only in Japan but worldwide (Yamamura, 2012).

as a whole (Putnam 1993; 2000; Hayami 2001).

Nuclear disasters can be considered an exogenous shock even if earthquakes and tsunamis can be, to a certain extent, predicted. Hence, nuclear disasters present as a natural experiment to assess the impact of such disasters on human behavior. However, while Japan can be regarded as a natural experiment to study the behavior of human beings, there is no current research investigating such behavior quantitatively. Thus, it is worthwhile to quantitatively investigate whether or not people engaged in collective action while experiencing an emergency situation.

Based on a rich dataset of the JPBL, this paper compares the determinants of game duration for the 2010 and 2011 seasons in an attempt to investigate how the occurrence of the Fukushima nuclear plant accident impacted on players' behavior. The remainder of this article is organized as follows. Section 2 presents the testable hypothesis. Section 3 describes the data and empirical method used. In Section 4, the estimation results and their interpretation are discussed. The final section offers some conclusions.

2. Hypothesis

Table 1 compares the duration of a game in the 2010 season with that in the 2011 season. Table 1 shows that the average duration of a game in the 2010 season was 192 minutes, while that in the 2011 season was 186 minutes. Thus, on average, the duration of a game in the 2011 season was 6 minutes shorter than that in the 2010 seasons. Further, the difference is statistically significant at the 1 percent level. The seasonal consumption of electricity varies according to weather conditions. Hence, it is worth comparing the duration of games in each month. In Japan, August records the highest temperatures, with an average temperature of 35 degree Celsius. This tendency is observed in both 2010 and 2011. Hence, it is necessary to use air-conditioning for players to maintain good physical condition. Consequently, the consumption of electricity increases, resulting in the high possibility of a power shortage during the summer of 2011. If this holds true, then the duration of a game will become shorter in the summer of 2011 to conserve electricity. As is presented in Table 1, however, the duration of a game increased from May to August, and then decreased from August to October. One reason why game duration could become longer during the summer is that the accumulation of fatigue, especially for the pitcher, is greater during the summer because of Japan's high temperatures and humidity. As a result, opponents can easily score runs in the summer, which increases the duration of the game. Table 1 also shows that with the exception of October, the average duration of a game is shorter in 2011 than in 2010. Further, the difference between 2010 and 2011 varies from 7 to 10 minutes during the July–September period, whereas it varies from 5 to 6 minutes during the March–June period. In addition, t-statistics during the July–September period is larger than the March–June period. It follows then that players had a greater incentive to reduce the duration of a game, especially during summer, in 2011 than in 2010.

The consumption of electricity is greater during workdays than holidays, in part because machinery and firms operate on workdays. As presented in Table 2, the duration of a game on a holiday day is longer than on a workday. It is also interesting to observe that the difference between them is only 1 minute in 2010 and is statistically insignificant, whereas the difference is 6 minutes in 2011 and is statistically significant at the 1 percent level. This can be interpreted to imply that the high possibility of a power shortage, as a result of the nuclear accident in 2011, provided a greater incentive for players to reduce workday games than holiday games.

Based on the discussion above, the following hypothesis is proposed:

Hypothesis: *The possibility of an electricity shortage gives players an incentive to reduce the duration of their games.*

3. Data and empirical method.

Data

This paper used game-level data from the 2010 and 2011 seasons. Games entering extra innings are excluded from the sample. There were 793 games that did not enter into extra innings in each season—a total of 1,586 observations for this paper. Information regarding the duration of games, date, where games were held, and game attendance are available from the official Nippon Professional Baseball website.[3] Information regarding the starting pitcher, such as his hometown, number of wins, payroll, and earned run average (ERA) was sourced from Takarajima Sha (for various years). The definition and basic statistics for the variables used for the estimations are presented in Table 3.

Method

To examine the empirical hypothesis raised in the previous section, the basic regression equation takes the following form:

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3 The data was accessed from August 1 to September 28, 2012.

$$Ln(Duration)_{it} = \alpha_o + \alpha_1 2011\ dummy_{it} + \alpha_2 Summer\ dummy_{it} + \alpha_3\ Holiday\ dummy_{it} + \alpha_4\ Ln(distance+1)_{it} + \alpha_5\ Ln(attendance)_{it} + \alpha_6\ Pacific\ dummy + \alpha_7\ Interleague\ dummy + \alpha_8 Home\ team\ win_{it} + \alpha_9 Visiting\ team\ win_{it} + \beta' X + \nu_{it},$$

where $Ln(Duration)_{it}$ represents the dependent variable (log form of the duration of a game) in prefecture *i,* and date of game *t*. The regression parameters for the variables used in the baseline model are denoted by α. Taking the log form of the continuous dependent and independent variables is useful to interpret the estimation result. Hence, apart from the dummy variables, *Duration, distance*, and *attendance* take a log form. The vector of the variable capturing the home team's (and visiting team) starting pitcher is denoted by X and β' is the vector for its parameter. The error term is denoted by ν_{ij} .[4] A simple OLS model was used for the estimation.

The key variable is *2011 dummy*, capturing the difference in the duration of games in the 2010 and 2011 seasons. If the nuclear accident gave players an incentive to reduce the duration of a game, *2011 dummy* will have the negative sign. As exhibited in Table 1, the duration of a game becomes longer in summer. *Summer dummy* is expected to have the positive sign. However, in contrast, *Summer dummy* also captures the increase in electricity consumption during the summer. The higher the possibility of an electricity shortage is, the greater the incentive for players to reduce the duration of a game. Hence, the positive effect of *Summer dummy* on the duration of a game is, to a certain extent, neutralized using the 2011 sample. Therefore, the value of the coefficient of *Summer dummy* is smaller in 2011 than in 2010, although the sign of

[4] The error terms for games held in the same month might correlate because conditions are shared. Otherwise, the standard errors of the coefficients might be biased downward (Moulton 1990). To control for this bias, robust standard errors are calculated by clustering in the month when the game was held. Then, t-values are obtained by the cluster–robust standard errors.

Summer dummy is positive. In addition, electricity consumption is larger on workdays than on holidays because firm activity levels are higher on workdays. Hence, *Holiday dummy* captures the low electricity consumption of holidays. Therefore, *Holiday dummy* reflects the low possibility of an electricity shortage. *Holiday dummy* is predicted to have the positive sign based on the 2011 sample because the low possibility of an electricity shortage reduces the incentive for players to reduce the duration of a game.

The impact of the Fukushima accident resulted in the closure of other nuclear plants in Japan. The last of Japan's nuclear plants stopped production in May 2012.[5] However, the supply of electricity was less likely to be influenced by the Fukushima accident immediately after the accident during 2011. The Great East Japan disaster and nuclear accident had a greater impact on game duration the shorter the distance between Fukushima and the location a game was played. If this holds true, the possibility of a power shortage was higher in areas closer to Fukushima. The location of a baseball arena seems to generate a social force and so influences the behaviors of the players as well as the referees (Sutter and Kocher 2004; Garicano et al. 2005; Dohmen 2008). Pressure on the players to save electricity was thus higher as the distance between Fukushima and the game was closer. *Ln(distance+1),* which captures the distance, is thus predicted to have the positive sign based on the 2011 sample.[6]

It seems plausible that Japanese people are sensitive to saving electricity and would appreciate efforts to save electricity after the nuclear accident. Therefore, they

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5 The No. 3 reactor of the Hokkaido Electric Power Co.'s Tomari nuclear power plant, which had been the only reactor operating in Japan, ceased production on May 5, 2012.

6 Distance takes a log form. I cannot obtain a value when a game was held in Fukushima because distance becomes 0. Therefore, to obtain a value, ln(distance +1) is used. Where a game was held in Fukushima, ln(distance +1) is 0.

would have attended a baseball game for enjoyment *and* to ensure that the players were making efforts to reduce the duration of the game for society's benefit under a restricted electricity supply. If this holds true, the greater the attendance is, the greater the incentive of players to reduce the duration of a game. Thus, the sign of *Ln(attendance)* is expected to be negative based on the 2011 sample.

The JPBL consists of the CL and PL, which is similar to the Major Baseball League in the United States, with its American and National Leagues. There are 12 teams in the JPBL. The PL and CL have six teams each. Originally, games are held between teams belonging to the same league. In 2005, games between PL and CL teams were introduced—these games are called interleague games, which follow the interleague between the American and the National leagues in the major baseball league in United States.[7] *Interleague dummy* is included to capture the effect of an interleague game. The reference group of the PL and interleague games is the CL game. *Pacific dummy* and *Interleague dummy* can be interpreted as to how and the extent to which the duration of the PL and interleague games differ from that of the CL game.

The Tohoku Rakuten Eagles belong to the PL. Their home city is Sendai, close to Fukushima, and it suffered direct damage in the 2011 earthquake. Hence, the Eagles are thought to have a greater incentive to save electricity as its players consider the issue of shortage of electricity very seriously. This effect continues to exist even when the Rakuten Eagles play a game away from their home city. Hence, this effect cannot be controlled even if *Ln(attendance)* was incorporated as an independent variable. Furthermore, the Rakuten Eagles possibly had a "peer effect" on the behavior of other teams in the PL. In contrast, none of the CL teams suffered directly from the Great East

[7] The Japanese interleague was introduced in the 2005 season.

Japan disaster. Thus, it can be predicted that in 2011 a PL game was shorter than a CL game. Hence, the predicted sign of the coefficient of *Pacific dummy* is negative.

Team performance during a season appears to affect the result of future games in that season. To capture this effect, *Home team win* and *Visiting team win* are incorporated as independent variables. Yamamura (2011) used data from JPBL games to show that the characteristics of the starting pitcher are associated with the result of a game. If the starting pitcher has a greater incentive to win or a greater ability to win, an opponent is less likely to score runs, resulting in low scoring game. In this case, the game progresses smoothly and the duration of a game is reduced. In addition to the pitcher, other players remain essentially the same during the season in the JPBL. Hence, the characteristics of the pitcher have a critical effect on the result of game, and therefore the duration of the game.

As suggested in Yamamura (2011), in the case that the starting pitcher's hometown is the town in which game was held, the starting pitcher has a greater incentive to win and so is likely to win the game. In contrast, if the starting pitcher is foreigner, he has a smaller incentive to win and so is less likely to win. For the purpose of capturing these effects, *Home (Visiting) pitcher's hometown* and *Home (Visiting) pitcher foreigner* are included. The coefficient sign of *Home (Visiting) pitcher's hometown* is predicted to be negative, whereas that of *Home (Visiting) pitcher foreigner* is predicted to be positive. As for the ability of the pitcher, a lack of experience within the JPBL suggests a smaller human capital so that an opponent can easily score runs. As consequence, the duration of a game increases; *Home (Visiting) pitcher rookie* captures this effect and the predicted sign is positive. A pitcher's statistics form the previous season reflects his ability. The higher the starting pitcher's ability is, the less an opponent is likely to score runs. Thus, the game score is thought to be lower. With the aim of capturing this effect, *Home (Visiting) pitcher ERA* and *Home (Visiting) pitcher win* are incorporated as independent variables. High *Home (Visiting) pitcher ERA* can be considered to suggest a pitcher's lower ability, while High *Home (Visiting) pitcher win* can be considered to suggest a pitcher's higher ability, Hence, *Home (Visiting) pitcher ERA* and *Home (Visiting) pitcher win* are expected to have positive and negative signs, respectively.

4. Estimation results

4.1. Baseline model

Table 4 presents the results based on integrated 2010 and 2011 game data. After splitting the sample into 2010 and 2011, an estimation was conducted to compare the influence of various factors for the 2010 and 2011 seasons. Estimation results based on 2010 data are exhibited in Table 5, and results based on 2011 data are presented in Table 6. Column (1) of Tables 4–6 shows the baseline model, which does not include the characteristics of the starting pitchers. Columns (2)–(4) of Tables 4–6 show the results of the models including various characteristics of the pitchers. Last season statistics are not available if the starting pitcher is a rookie. Hence, the sample size is reduced in columns (3) and (4).

The first row of Table 4 shows that the sign of *2011 dummy* is negative and statistically significant at the 1 percent level in all estimations. Further, the absolute value is approximately 0.03, meaning that the duration of a game in 2011 was 3 percent shorter compared with 2010 games. Consistent with expectations, this suggests that players made a greater effort to reduce the duration of their games in 2011 compared with 2010. The second row shows that the coefficient sign of *Summer dummy* is positive and statistically significant at the 1 percent level in all estimations. Further, its absolute value is 0.04, suggesting that the duration of a game during the summer period was 4 percent longer than other in seasons, which is congruent with Table 1. *Holiday dummy* produces the positive sign and is statistically significant at the 5 percent level in all columns, and its absolute value is approximately 0.02, showing that the duration of a game played on a holiday was 2 percent longer than a workday game. This is in line with the results shown in Table 2.

Ln(disaster+1) and *Central dummy* produce the positive sign in all columns. Further, with the exception of column (3), they are statistically significant. In contrast, *Ln(attendance)* yields a significant negative sign in all estimations. These results are consistent with the predictions. However, the effects of these variables are thought to show a clear difference between the 2010 and 2011 seasons because they would be unlikely to influence the duration of a game if the Fukushima nuclear accident had not occurred.

Concerning the characteristics of the starting pitchers, *Home pitcher's hometown* is observed to have the negative sign and show statistical significance in all estimations. The absolute value of its coefficient is 0.02, meaning that the duration of a game was 2 percent shorter when the game was played in the hometown of the home team's starting pitcher. As argued by Yamamura (2011), the starting pitcher has a greater incentive to win when he plays in his hometown. As a consequence, it is more difficult for an opponent team to score runs, leading to a shorter game duration. What is more, *Home pitcher ERA* and *Visiting pitcher ERA* show a positive and statistically significant sign. In contrast, *Home pitcher win* and *Visiting pitcher win* show a negative and statistically significant sign. These results suggest that the duration of a game is reduced when the starting pitchers have a greater ability because an opponent will have difficulty in scoring runs off a highly skilled pitcher. All in all, as expected earlier, the characteristics of starting pitchers obviously have an impact on the duration of a game.

4.2. Results based on the subsample

To compare the effect of each determinant for the duration of a game in 2010 and 2011, I now turn to the results based on the 2010 and 2011 subsamples. Table 5 shows that *Summer dummy* has the positive sign and is statistically significant at the 1 percent level in columns (1)–(4). This implies that pitchers' fatigue accumulates and that their performance tends to decline as the season progresses. Hence, this effect is not considered as an outcome of the nuclear accident. It is interesting to observe that *Holiday dummy, Ln(distance +1), Ln(attendance)*, and *Central dummy* do not show statistical significance, with the exception of column (1) for *Ln(attendance)*. The results of these variables are obviously different from those reported in Table 4. These variables have no effect on the duration of a game.

As for Table 6, *Summer dummy* continues to produce the positive sign and is statistically significant at the 1 percent level in all columns. Its absolute value of the coefficient is approximately 0.04, which is 0.01 smaller than its value reported in Table 5. This implies that in comparison with 2010, players made more of an effort to reduce the duration of games played during the summer. Results of *Holiday dummy, Ln(distance +1), Ln(attendance)*, and *Central dummy* have the predicted sign and are statistically significant in most of the estimations, which is similar to the results in Table 5. The absolute value of the coefficient of *Ln(distance +1)* is 0.01–0.02, meaning that a 1 percent increase in the distance between the location of a game and Fukushima leads to a 0.01–0.02 percent increase in the duration of a game. The absolute value of the coefficient of *Ln(attendance)* is 0.04, implying that a 1 percent increase in attendance at a game leads to a 0.04 percent decrease in the duration of a game. The absolute value of the coefficient of *Pacific dummy* is approximately 0.02, reflecting that the duration of a PL game is 2 percent shorter than a CL game.

Thus, the results of Tables 5 and 6 reveal a remarkable difference in the results of these variables between 2010 and 2011.

4.3. Model with interaction terms

To further examine the different effects of the determinants in 2010 and 2011, Table 7 shows the results of the interaction term between *2011 dummy* and each variable. Here I concentrate on the variables investigating the impact of the nuclear accident and so do not show or discuss the results of the control variables regarding the characteristics of the team and the statistics of the starting pitchers, although they are include as independent variables.

A significant negative sign of the coefficient of *2011 dummy*Summer dummy* is observed in columns (1) and (4) of Table 7. This can be interpreted as suggesting that the duration of a game in 2011 summer was approximately 1 percent shorter than in the summer of 2010. The coefficient of *2011 dummy*holiday dummy* yields the positive sign and is statistically significant. Its coefficient's absolute value is 0.02, suggesting that difference in the duration of a game played on a holiday day and a workday was 2 percent longer in 2011 than in 2010. In my interpretation of the combined results of Tables 2 and 6, players had a greater incentive to reduce the duration of a game on a workday than on holiday in 2011, whereas there is no difference between the two in 2010. Hence, as a consequence of the electricity crisis, players had a different incentive for workday games compared with holiday games, and thus their behavior changed. The coefficient of *2011 dummy*Ln(distance+1)* has the positive sign, while being statistically significant. I interpret this as implying that the distance between the location where a game was played and Fukushima had a significantly larger positive effect on the duration of a game in 2011 than in 2010. It follows from these cross terms that in comparison with 2010, the duration of a game in 2011 is more likely to depend on factors related to the possibility of an electricity shortage. Hence, the emergency situation is thought to have enhanced the collective action of the JPBL players for the sake of society, rather than in the pursuit of individual interests.

Overall, the findings presented in this section strongly and consistently support the hypothesis proposed in Section 2. Through various channels, an exogenous shock that increased the possibility of an electricity shortage had a critical effect on the behavior of players, causing them to reduce the duration of their games to save electricity. The efforts of an individual player make only a small contribution to averting an electricity shortage and are not taken into account when his performance is evaluated. Such an effort is only effective, and therefore will influence the possibility of a power shortage, when a number of players and teams participate in a collective action. The results of the various estimations in this study suggest that the Great East Japan Earthquake, followed by the massive tsunami and nuclear accident, played a critical role in the formation of a norm, regarded as an informal rule, to engage in collective action.

5. Conclusion

The Great East Japan Earthquake in 2011 was followed by the Fukushima nuclear accident. Such an unforeseen devastating event, considered as an exogenous shock, had a detrimental effect on Japan’s electricity supply. It was predicted that an electricity shortage would cause a major power failure. Thus, it was necessary for people to save electricity to avoid such a crisis. However, the price of electricity remained fixed even after the Fukushima accident in Japan. That is, the market mechanism did not properly function in the electricity market. From the viewpoint of standard economics, people did not have an incentive to save electricity. Furthermore, concerning saving electricity, there was no mandatory saving requirements enforced by a third party, although the government did request that people try to reduce their electricity consumption. Under such a situation, if people are individualistic, they will not change their lifestyle to save electricity. As a consequence, a major power failure would be unavoidable.

It was collective action that solved the problem regarding saving electricity. In the case of the JPBL, the evaluation of the baseball players’ performance was based on their contributions to win the game. The duration of a game is not related to the players’ performance. Hence, players have no incentive to reduce the duration of a game if they are individualistic and behave to improve their performance to win the game. However, a reduction in the duration of a game contributed to save electricity under Japan’s emergency situation. This paper used baseball game data to investigate how people engaged in collective action to avoid further chaos in the wake of the earthquake.

The major findings are as follows. (1) The duration of a game in the 2011 season was shorter than that in 2010, especially during the summer period when Japan was experiencing an electricity shortage. (2) The duration of a game played on a holiday was longer than a workday game in 2011, whereas there was no difference in the duration of a holiday and workday game in 2010. (3) The greater the distance between Fukushima and the location that the game was played, the longer the duration of a game in 2011. This was not observed for 2010. Thus, the higher probability of an electricity shortage gave players the incentive to engage in collective action to reduce the duration of their games. Informal norms or social capital are important to solve problems requiring collective action if the market and government are unable to function well. It was reported that the Japanese people did not turn the situation into one of confusion and turmoil, even immediately after the Great East earthquake. This might in part be because of norm shared by Japanese people, and consistent with the case study in this paper that suggests that the emergency situation created an informal rule among JPBL players to save electricity.

The findings of this paper are based on JPBL data, and so it is inconclusive whether the behavior of the baseball players would be generally observable in all Japanese people. Hence, further research based on data of other industries in Japan should be conducted to test the generality of these finding. What is more, norms and perceptions seem to vary between Japan and the Western countries, such as the United States and European countries, due to different historical and cultural backgrounds. It would be worthwhile to compare the behavior of people in these countries in emergency situations. Thus, further comparative studies should be conducted in the future.

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Table 1.

Comparison of game duration in 2010 and 2011

	2010	2011	Difference (2011–2010)	Absolute t-value
Whole season (March–October)	192	186	- 6	5.81***
March–April	182	188	–6	1.84*
May	188	183	–5	1.62
June	189	183	–6	2.09**
July	194	187	–7	2.48**
August	200	190	–10	3.45***
September	198	189	–9	2.82***
October	176	180	4	0.63

Notes: Values in parentheses are the number of observations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2.

Comparison of game duration on a workday and holiday

	Workday	Holiday	Difference (workday-holiday)	Absolute t-value
2010	192	193	–1	0.48
2011	183	189	–6	3.11***

Notes: Values in parentheses are number of observations. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Mean values for the Pacific and Central leagues

Variables	Definition	Mean	Standard deviation
Duration	Duration of a game (minutes)	189.4	23.4
2011 dummy	1 when the game was held in 2011, otherwise 0	0.50	--
Summer dummy	1 when the game was held in July, August, or September, otherwise 0	0.49	--
Holiday dummy	1 when the game was held on a holiday, otherwise 0	0.41	--
Distance	Distance between Fukushima city and prefectural capital where a game was held (km)	444.4	278.4
Attendance	Attendance per game	25,369	11,565
Pacific dummy	1 when the game was a Pacific League game, otherwise 0.	0.50	--
Interleague dummy	1 when the game was an interleague game, otherwise 0	0.15	--

Characteristics of team			
Home team win[a]	Home team's win rate during the current season	0.48	0.11
Visiting team win[a]	Visiting team's win rate during the current season	0.48	0.10
Characteristics of starting pitcher			
Home pitcher's hometown	1 when game is held in the hometown of the home team's starting pitcher, otherwise 0	0.05	--
Home pitcher foreigner	1 when home team starting pitcher is a foreigner, otherwise 0	0.18	--
Home pitcher rookie	1 when the home team starting pitcher is a rookie, otherwise 0	0.10	--
Home pitcher ERA	Home team starting pitcher's run average in the previous season	4.06	2.06
Home pitcher win	Number of wins of home team's starting pitcher in the previous season	6.02	5.38
Visiting pitcher's hometown	1 when the game is played in the hometown of the visiting team's starting pitcher, otherwise 0	0.02	--
Visiting pitcher foreigner	1 when the visiting team's starting pitcher is a foreigner, otherwise 0	0.20	--
Visiting pitcher rookie	1 when the visiting team's starting pitcher is a rookie, otherwise 0	0.11	--
Visiting pitcher ERA	Visiting team's starting pitcher's earned run average in the previous season	4.15	2.25
Visiting pitcher win	Number of wins of visiting team's starting pitcher in the previous season	5.64	5.29

Note: [a] Winning percentage in the current season prior to the game.

Table 4. Determinants of the duration of a game based on 2010 and 2011 seasons

Variables	(1)	(2)	(3)	(4)
2011 dummy	–0.03***	–0.03***	–0.04***	–0.03***
	(–9.09)	(–9.01)	(–8.81)	(–9.36)
Summer dummy	0.04***	0.04***	0.04***	0.04***
	(5.43)	(5.50)	(7.28)	(5.36)
Holiday dummy	0.02**	0.03**	0.02**	0.02**
	(3.24)	(3.37)	(2.90)	(2.1)
Ln(distance+1)	0.01**	0.01**	0.004	0.009**
	(3.37)	(3.34)	(0.82)	(3.36)
Ln(attendance)	–0.03***	–0.03***	–0.03***	–0.02***
	(–6.38)	(–6.51)	(–6.93)	(–6.04)
Pacific dummy	–0.01**	–0.01**	–0.01	–0.01*
	(–2.92)	(–2.43)	(–1.81)	(–2.24)
Interleague dummy	0.001	0.001	–0.005	0.001
	(0.15)	(0.10)	(–1.37)	(0.17)
Characteristics of team				
Home team win	–0.04*	–0.03	–0.04	–0.03
	(–1.97)	(–1.70)	(–1.32)	(–1.58)
Visitor team win	0.06	0.05*	0.03	0.06**
	(1.93)	(1.99)	(1.06)	(2.41)
Characteristics of starting pitcher				
Home pitcher's hometown		–0.02*	–0.02**	–0.02*
		(–2.00)	(–2.74)	(–2.00)
Home pitcher foreigner		0.01*	0.02**	0.007
		(2.26)	(2.86)	(1.70)
Home pitcher rookie		0.01		0.007
		(0.96)		(0.61)
Home pitcher ERA			0.003***	
			(3.82)	
Home pitcher win				–0.001**
				(–2.63)
Visiting pitcher's hometown		0.02	0.02	0.02
		(1.05)	(1.24)	(1.33)
Visiting pitcher foreigner		0.008	0.02*	0.003
		(1.10)	(1.90)	(0.44)
Visiting pitcher rookie		0.003		–0.007
		(0.41)		(–0.90)
Visiting pitcher ERA			0.003*	
			(2.01)	
Visiting pitcher win				–0.001**
				(–2.38)
Constant	5.46***	5.45***	5.52***	5.44***
	(87.4)	(85.3)	(83.7)	(96.8)
Observations	1586	1586	1012	1584

Notes: Numbers in parentheses are t-values calculated using robust standard errors clustered at the month. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Determinants of the duration of a game based on the 2010 season

Variables	(1)	(2)	(3)	(4)
Summer dummy	0.05***	0.05***	0.05***	0.04***
	(4.91)	(4.79)	(6.33)	(4.61)
Holiday dummy	0.01	0.01	0.008	0.01
	(1.32)	(1.38)	(1.10)	(1.23)
Ln(distance+1)	0.003	0.003	–0.007	0.002
	(0.97)	(0.94)	(–0.96)	(0.53)
Ln(attendance)	–0.01*	–0.01	–0.01	–0.01
	(–1.92)	(–1.70)	(–1.28)	(–1.54)
Pacific dummy	–0.005	–0.003	–0.004	–0.001
	(–0.86)	(–0.59)	(–0.63)	(–0.20)
Interleague dummy	–0.002	–0.002	–0.005	–0.003
	(–0.21)	(–0.16)	(–0.42)	(–0.25)
Characteristics of team				
Home team win	–0.03	–0.03	–0.05	–0.03
	(–1.14)	(–0.95)	(–1.14)	(–1.05)
Visiting team win	0.04	0.04	0.02	0.01
	(1.33)	(1.39)	(1.09)	(0.99)
Characteristics of starting pitcher				
Home pitcher's hometown		–0.01	–0.02	–0.01
		(–1.00)	(–1.01)	(–1.21)
Home pitcher foreigner		0.02	0.06***	0.01
		(1.37)	(3.59)	(0.99)
Home pitcher rookie		–0.009		–0.01
		(–0.64)		(–1.21)
Home pitcher ERA			0.005*	
			(2.03)	
Home pitcher win				–0.001**
				(–3.15)
Visiting pitcher's hometown		0.03*	0.04	0.04**
		(2.08)	(1.66)	(2.94)
Visiting pitcher foreigner		0.004	0.02	–0.001
		(0.81)	(1.80)	(–0.14)
Visiting pitcher rookie		0.004		–0.007
		(0.79)		(–1.89)
Visiting pitcher ERA			0.007***	
			(4.29)	
Visiting pitcher win				–0.001
				(–1.71)
Constant	5.36***	5.38***	5.39***	5.37***
	(55.4)	(44.9)	(54.5)	(48.3)
Observations	793	793	490	791

Notes: Numbers in parentheses are t-values calculated using robust standard errors clustered at the month. ***, ** and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Determinants of the duration of a game based on the 2011 season

Variables	(1)	(2)	(3)	(4)
Summer dummy	0.04***	0.04***	0.04***	0.04***
	(4.92)	(4.91)	(4.27)	(5.00)
Holiday dummy	0.04***	0.04***	0.04**	0.04***
	(3.77)	(3.97)	(2.98)	(3.80)
Ln(distance+1)	0.01***	0.02***	0.02***	0.01***
	(4.20)	(4.38)	(4.21)	(4.49)
Ln(attendance)	–0.04***	–0.04***	–0.04**	–0.04**
	(–4.33)	(–3.77)	(–2.94)	(–3.65)
Pacific dummy	–0.02**	–0.02*	–0.01	–0.02*
	(–2.74)	(–2.41)	(–1.17)	(–2.42)
Interleague dummy	0.006	0.006	–0.002	0.007
	(0.88)	(0.89)	(–0.26)	(1.03)
Characteristics of team				
Home team win	–0.06	–0.05	–0.08**	–0.04
	(–1.79)	(–1.62)	(–2.70)	(–1.50)
Visiting team win	0.06	0.06	–0.001	0.07*
	(1.86)	(1.61)	(–0.03)	(2.04)
Characteristics of the starting pitcher				
Home pitcher's hometown		–0.03*	–0.03**	–0.03*
		(–2.32)	(–2.97)	(–2.32)
Home pitcher foreigner		–0.001	–0.01	–0.001
		(–0.07)	(–0.74)	(–0.01)
Home pitcher rookie		0.02		0.02
		(1.32)		(1.38)
Home pitcher ERA			0.003*	
			(2.07)	
Home pitcher win				0.0002
				(0.04)
Visiting pitcher's hometown		0.01	0.007	0.01
		(0.27)	(0.18)	(0.29)
Visiting pitcher foreigner		0.01	0.02	0.008
		(1.33)	(1.42)	(1.01)
Visiting pitcher rookie		0.003		–0.003
		(0.37)		(0.25)
Visiting pitcher ERA			0.001	
			(0.50)	
Visiting pitcher win				–0.001
				(–1.27)
Constant	5.37***	5.51***	5.51***	5.51***
	(58.8)	(48.5)	(31.3)	(49.7)
Observations	793	793	522	793

Notes: Numbers in parentheses are t-values calculated using robust standard errors clustered at the month. ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Effect of cross terms on the duration of a game based on 2010 and 2011seasons

Variables	(1)	(2)	(3)	(4)
2011 dummy Summer dummy*	–0.01** (–3.39)			–0.009** (–2.60)
2011 dummy holiday dummy*		0.02** (3.42)		0.02** (3.06)
2011 dummy Ln(distance+1)*			0.01* (2.32)	0.01* (2.01)
2011 dummy	–0.03***	–0.04***	–0.09***	–0.09***
	(–16.4)	(–7.39)	(-4.02)	(–4.04)
Summer dummy	0.04***			0.04***
	(4.90)			(5.25)
holiday dummy		0.008		0.01*
		(1.08)		(1.93)
Ln(distance+1)			0.004	0.005
			(0.14)	(1.66)
Constant	5.35***	5.42***	5.37***	5.47***
	(102.5)	(70.3)	(66.2)	(102.4)
Observations	1584	1584	1584	1584

Notes: All variables used in column (4) of Table 3 are included although their results are not reported. Sample is equivalent to column (4) of Table 3. Numbers in parentheses are t-values calculated using robust standard errors clustered at the month. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.