



The Impact of the Announcement of Japan's Nuclear-contaminated Water Discharge Policy on Consumption

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Abstract. On January 13, 2023, the Japanese government announced nuclear-contaminated water discharge policy, which aroused consumers' concerns about the safety of seafood products. From an ESG perspective, this article explores the impact of the announcement of this policy on consumption. This article uses multiple regression and takes policy shock as the core explanatory variable to explore the influencing factors of sales changes. Although the announcement of the policy did not affect seafood products quality, We found that the Japanese government's actions violated ESG standards, damaging the reputation of seafood products and resulting in a decline in consumers' willingness to purchase them.

Keywords: ESG, Product reputation, Nuclear-contaminated water discharge policy, Consumption

1 Introduction and Motivation

ESG (Environmental, Social and Governance) is an evaluation system for measuring the sustainability performance of businesses and organizations, and can be used as one of the bases for judging the long-term value of a company. Currently, the development of ESG is making rapid progress globally. More and more companies, investors, governments and international organizations are beginning to pay attention and take action to promote sustainable development and responsible business practices. Will the popularity of ESG concepts influence consumers' choices, so that consumers' product choices are not only influenced by traditional factors such as brand quality and price, but also include the environmental protection, social responsibility and good governance emphasized by the ESG system as important considerations in their purchasing decisions? This paper will investigate the impact of ESG on consumption based on this question.

On 13 January 2023, the Government of Japan announced the release of nuclear contamination, confirming that the Fukushima nuclear effluent is expected to be discharged into the sea around the spring and summer of 2023, an act of decision-making that has attracted the attention of Governments because of its incalculable subsequent impacts. Nuclear contaminated water threatens the marine ecosystem, the marine food

industry and human health. In the short term, nuclear contaminated water will mainly affect the development of the fisheries and fishing industry in Japan itself and in neighboring countries; in the long term, the marine ecological security of the North-east Asian region, the Pacific region, and the international community will inevitably be threatened (Wu Wei, 2023) [1]. From the perspective of consumers, although the Japanese government's announcement does not have any impact on the quality of the seafood products it produces in the present, this decision may raise consumers' concern about the safety of seafood products, and the government's action may still negatively affect the brand reputation of Japanese products, which in turn may affect consumers' consumption behavior.

In previous consumer markets, reputation and quality were often intertwined, such as in the Sanlu milk powder incident, the decline in products' quality led directly to the decline in reputation, which in turn led to a decrease in sales. The simultaneous decline in reputation and product quality makes it difficult to assess the impact of a single factor on sales. The announcement of Japan's nuclear-contaminated water discharge policy, however, provides an opportunity to study the impact of product reputation on sales. The unique situation in which the reputation of a Japanese-produced seafood product is damaged while product quality remains unchanged allows us to study the direct effect of changes in reputation on sales without the interference of changes in product quality. This separation is key to understanding consumer behavior and market dynamics as it reveals consumer responses to corporate social responsibility and environmental behavior that may be unrelated to the actual quality of the product.

By examining the impact of this policy announcement, we can gain a deeper understanding of how consumers adjust their purchasing decisions in the face of reputational damage. This is particularly important for understanding the role of ESG factors in modern business environments, especially in the context of the growing global interest in sustainability and corporate responsibility. Therefore, this study not only contributes to assessing the actual impact of Japanese policies, but also provides valuable insights into understanding the role of product reputation and consumer trust in product sales.

Specifically, the theoretical foundations and the data used for this project are discussed first. Then, we set the model and modelling procedures are summarized in detail. Finally, the conclusions and possible future extensions are stated.

2 Theoretical Foundations

The theoretical underpinnings of this study are deeply rooted in the fields of consumer behavior, environmental economics, and ESG criteria.

Our study is informed by the consumer behavior literature, which posits that consumer decisions are influenced by a variety of factors, including product quality, price, and reputation (Zeithaml, 1988) [2]. Consumers are faced with the challenge of incorporating this new, complex, and potentially risky information into their purchasing decisions. This aligns with the information processing theory, which suggests that

consumers' limited cognitive capacity affects how they process and use information to make decisions (Payne et al., 1993) [3].

ESG effect Consumers' decision-making. The growing importance of ESG criteria in consumer decision-making is a key aspect of our theoretical framework. Research indicates that consumers are increasingly considering a company's ESG performance when making purchase decisions (Ellen et al., 2006) [4]. The environmental dimension is particularly relevant here, as the nuclear contamination policy directly affects the environment and public health, which are key concerns for consumers. Besides, the concept of socially responsible investment (SRI) is closely related to ESG and provides a theoretical basis for understanding how ethical considerations, including environmental protection, influence investment and consumption behaviors (Aldowaiash, 2022) [5]. Consumer trust, which is a critical component of SRI, may be eroded by policies perceived as environmentally harmful, leading to a decline in demand for associated products.

The Role of Government Policy in Shaping Consumer Behavior is also important. Government policies are known to shape consumer behavior through their impact on market signals, information provision, and regulation (Viscusi et al., 2005) [6]. In the context of Japan's nuclear contamination policy, government actions directly influence the perceived risk and acceptability of consuming seafood products, thereby influencing consumer behavior.

3 Data

3.1 Data Source

All the financial data used for this project are extracted from HKTV mall, the largest E-commerce platform in Hong Kong. In this paper, we use January 13th, 2023 (Japan's nuclear contamination discharge date) as a reference. We selected HKTV sales data from January 6th to 20th, 2023. Focusing on seafood concerns, we screened data for Japanese products categorized as Frozen and Chilled Seafood.

3.2 List of Variables

3.2.1 Data Adjustment

The HKTV mall offers over 100 variables, This paper uses Quantity as the explanatory variable to measure the change of consumption, and then preliminarily identify several variables affecting consumption as explanatory variables and make data adjustment on some variables, the adjustment process is as shown in Table 1:

Table 1. Data adjustment

Variable	Adjustment
total_discounts(%)	0 for 0-0.5, median for the rest
total_price	take the median
unit_price	total_price/quantity

policy shock	The order_date is 0 before January 13th, and 1 on January 13th and thereafter.
area	Missing values are filled with UNKNOWN
night	order_time_range takes 0 for 09-21 and 1 for 21-09.

3.2.2 Control Group

Product sales can vary with time trends, especially around significant events like Chinese New Year, which affects consumer behavior, notably in food consumption. To isolate the impact of the nuclear-contaminated water discharge policy on consumption, we need a control group to account for time effects. We selected European seafood as the control because it shares the same time trend as Japanese seafood and is perceived as safer by consumers due to Europe's geographical distance from Japan. This control allows us to more accurately assess the policy's effect on consumption and enhance the study's accuracy and reliability.

3.2.3 Variable Definitions

3.2.3.1 Core Explanatory Variable - Policy Shock.

We're examining how Japan's nuclear-contaminated water discharge announcement affects consumption. We've defined a dummy variable for policy shock: it's 0 for those unaffected by the policy and 1 for those affected. Specifically, seafood from Japan ordered on or after January 13, 2023, is coded as 1, while Japanese seafood ordered before the announcement is coded as 0. European seafood is also coded as 0. The detailed classification is in Table 2.

Table 2. Policy shock definitions

Policy shock	Manufacturing country	Order date
1	Japanese	13th - 20th January
0	Japanese	6 January-12 January
	European countries	13th - 20th January

3.2.3.2 Other Explanatory Variables.

Time-of-day effect: Temporal variables have been widely explored, the effect of time within a day has gradually attracted researchers' attention. Variety seeking is highly related to the time of day (Gullo, 2019) [7]. Based on this, we added order_time_range to investigate whether order time has an effect on consumption, and there are also studies that show that people may have more impulsive behaviors in the evening due to ego depletion, so we divided the order time again, defining the order time in the range of 21-09 as the evening (1), and the time of placing an order in the range of 09-21 defined as daytime (0), and also generate the variable night;

As demonstrated in Figure 1, when visualizing the sales of seafood products from December 2022-February 2023, it can be observed that the sales fluctuate cyclically and the wave peaks are all on Wednesdays, in order to control for the inherent intra-

week variation, we include the weekday effect in order to more accurately assess the impact of the specific event of declaring the policy, therefore we include the dummy variable weekday to eliminate the inherent volatility.

In addition, we consider that the user's location may reflect his/her consumption level as well as the immediacy of delivery may affect the consumer's choice. In summary, we choose `unit_price`, `total_discounts` in terms of product variables; `order_time_range`, `area`, `delivery_way`, `night` in terms of consumers' characteristics; and `weekday`, a variable used to offset the weekday effect.

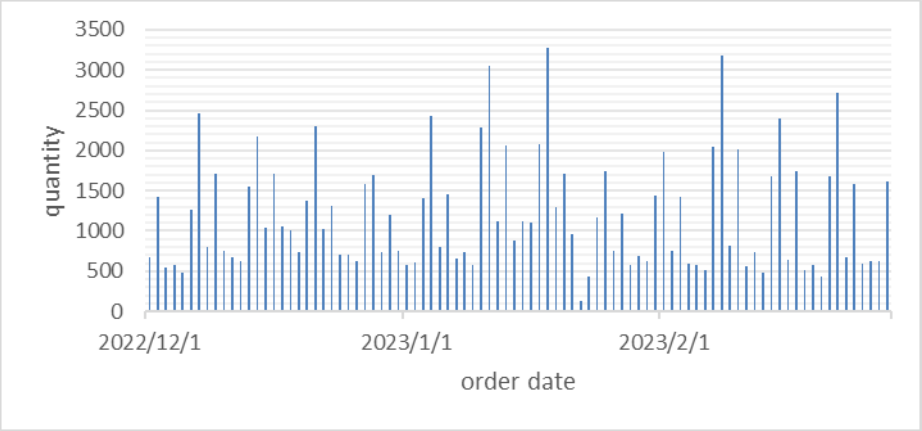


Fig. 1. The sales of seafood products

The adjusted variables list is shown in Table 3:

Table 3. Variable description

Variable	Description	categorisation
quantity	Product sales	
policy shock	Impact of the nuclear-contaminated water discharge policy Declarations	If the manufacturing country of the seafood is Japan and the order date is before January 13th, and if the manufacturing country of the seafood is in Europe, it is 0. If the manufacturing country is Japan and the order date is on or after January 13th, it is 1.
unit_price	Unit price per product	
total_discounts (%)	Product Discounts	
weekday	The day of the week on which the order was placed	monday-sunday
order_time_range	creation timeslot of the order	00-09, 09-12, 12-15, 15-18, 18-21, 21-24

area	The area of delivery address	NT for New Territories, HK for Hong Kong Special Administrative Region, KLN for Kowloon
delivery_way	The way to deliver	day group shipment. immediate shipment
night	Orders are placed in the evening	0, 1

4 Modelling

4.1 Model Settings

In order to investigate the impact of Japan's declared nuclear pollution emission policy on consumption, we construct a multiple regression model:

$$\begin{aligned} \log_quantity = & \alpha_0 + \alpha_1 \text{policy shock} + \alpha_2 \log \\ & _unit_price + \alpha_3 \text{total_discounts} + \alpha_4 \text{order_time_range} + \alpha_5 \text{area} + \alpha_6 \text{delivery_way} + \alpha_7 \text{night} \\ & + \alpha_8 \text{policy shock} * \text{night} + \epsilon \end{aligned} \quad (1)$$

Where $\log_quantity$ is the explanatory variable, here we perform a logarithmic transformation on quantity and $_unit_price$ to reduce the heteroskedasticity problem of the model, in addition to the variables introduced above, we also guess that the impact of the policy announcement on consumption may also depend on whether order time is at night or not, so we add the interaction between policy shock and night term and further verify its significance.

5 Analysis of Empirical Results

5.1 Descriptive Statistics

Experimental group for orders of seafood products whose manufacturing country is Japan and control group for orders of seafood products whose whose manufacturing country is in Europe. The Descriptive statistics result is shown in Table 4.

Table 4. Descriptive statistics

Group	Variable	sample	avg	sd	min	med	max
Experimental Group	quantity	18966	1.23	0.62	1	1	20
	policy shock	18966	0.56	0.49	0	1	1
	_unit_price	18966	119.18	63.19	0.25	125	750
	total_discounts	18966	29.01	99.71	0	0	2700
	night	18966	0.30	0.45	0	0	1
Control Group	quantity	21091	1.52	0.93	1	1	16
	policy shock	21091	0	0	0	0	0
	_unit_price	21091	75.74	42.20	0.04	75	1550

total_discounts	21091	28.47	87.78	0	0	2700
night	21091	0.34	0.48	0	0	1

5.2 Regression Results

Table 5. Regression results

Variable	log_quantity	t-value	P> t	VIF
policy shock	-0.0883***	-16.364	0.000	1.536
log_unit_price	-0.0743***	-25.327	0.000	1.104
total_discounts (%)	8.696e-05***	4.098	0.000	1.059
weekday_Tuesday	-0.0495***	-5.829	0.000	3.030
weekday_Wednesday	-0.0293***	-3.594	0.000	3.714
weekday_Thursday	0.0023	0.245	0.806	2.079
weekday_Friday	-0.0091	-1.066	0.287	3.010
weekday_Saturday	-0.0085	-0.834	0.404	1.818
weekday_Sunday	-0.0185*	-1.883	0.060	1.954
area_KLN	-0.0088	-1.269	0.204	1.829
area_NT	-0.0097	-1.611	0.107	2.266
area_UNKNOWN	0.0422***	6.156	0.000	2.702
delivery_way_2-day group shipment	-0.0548***	-11.111	0.000	1.172
night	-0.0325***	-6.335	0.000	1.548
policy shock * night	0.0176*	1.838	0.066	1.736
constant term (math.)	0.6118***	38.769	0.000	66.797
adjustedR ²	0.038			
F-value	107.1		0.00	
sample size	40057			

Note: *p<0. 1, **p<0. 05, ***p<0. 01

The regression results are shown in Table 5, we find that:

Firstly, policy shock is significantly negative to log_quantity at the 1% level, after the announcement of this policy,the quantity decreased by $1-\exp(-0.0883)$.The decrease is measured at 8.45% in percentage terms, which decrease a lot.It indicates that the sales of seafood products declined after the announcement of the nuclear-contaminated water discharge policy, suggesting that the announcement of this policy has caused concern about seafood and affected people's consumption choices. Secondly, log_unit_price and total_discounts have a significant effect on log_quantity at the 1% level, and the higher the unit price, the lower the quantity, and log_quantity

decreases by 0.074 when $\log_unit_price$ rises by one unit. Thirdly, the dummy variables Tuesday and Wednesday are significantly negative at the 1% level compared to the dummy variable Monday, indicating that sales of seafood products on Tuesday and Wednesday are significantly lower than sales of seafood products on Monday. Fourthly, night is significantly positive to $\log_quantity$, indicating that people are more inclined to order seafood products at night, and there is a time effect on consumers' online shopping habits. Besides, compared to immediate shipment, sales of products with 2-day group shipment are significantly negative. It suggests consumers are more likely to buy seafood with quicker delivery methods. At last, Interaction term **policy shock * night** has a significant effect on $\log_quantity$ at the 10% level, with policy shock changing from 0 to 1, which means Japan has declared its policy on nuclear-contaminated water discharge.

night=1 $\Delta quantity = -0.0724$

night=0 $\Delta quantity = -0.0886$

This result suggests that the decline in consumption is relatively small at night, implying that consumers may be less sensitive at night to the policy change in Japan's announcement of nuclear-contaminated water discharge. This may be related to the impulsive buying characteristic of nighttime consumption behavior, where consumers may be more susceptible to immediate emotions and thus make impulsive purchases (Zhang Sha & Wu Xiting, 2024) [8]. This phenomenon, in turn, is due to the influence of the circadian rhythm effect. The circadian rhythm effect guides individuals to respond at specific times in the morning and evening that match their current physiological state by modulating their physiological arousal levels, self-control, and other variables.

People typically have more self-control in the morning, which diminishes as the day progresses due to decision fatigue, leading to increased impulsiveness in the evening. This affects nighttime consumer behavior, making people more likely to seek immediate gratification rather than rational planning. The pattern shows that people are more prone to order seafood at night and are less sensitive to the implications of Japan's nuclear-contaminated water discharge policy, leading to impulsive purchases and reduced responsiveness to policy changes.

6 Changes in Consumer Behavior from an ESG Perspective - the Impact of Policy Shock on Quantity

Although the Japanese government's nuclear-contaminated water discharge policy has not yet been enforced and has not actually altered the quality of seafood products, its influence on consumer behavior is already evident, manifesting as a decline in people's willingness to purchase seafood. This suggests that product reputation can directly impact consumer choices even when product quality remains unchanged. This phenomenon may be due to the popularity of ESG concepts influencing consumers' consumption choice.

From the environment dimension, the announcement of the policy has sparked widespread public concern to the marine environment. Japan's nuclear contamination

discharge policy goes against the public's expectations of the Japanese government's dedication to environmental protection, leading consumers to doubt the safety of Japanese seafood products.

From the social dimension, The Japanese government's lack of social responsibility, as highlighted by Wu Wei (2023), is a major cause of falling sales. Japan's nuclear-contaminated water discharge policy disregards social welfare and public health, violating legal norms and international cooperation principles. This has tarnished Japan's reputation for social responsibility, eroding consumer trust in its seafood products.

From the governance dimension, the Japanese government's handling way is perceived as a lack of transparency and accountability and directly affects the evaluation of the country's governance.

Therefore, as shown in Figure 2, Japan's announcement of its nuclear-contaminated water discharge policy, even though it does not directly affect the quality of its products, the Japanese government is ignoring the real worries of the world.

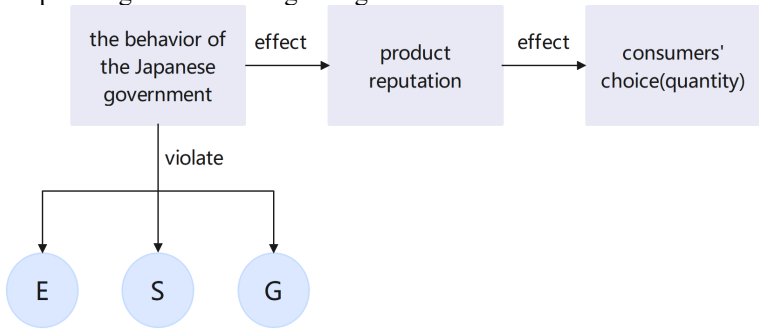


Fig. 2. The impact of reputation on sales

7 Conclusion and Possible Extension

The aim of this paper is to explore the impact of the Japanese government's announcement of its nuclear-contaminated water discharge policy on consumers' consumption choices from an ESG perspective. Without the product quality being directly affected, this study will focus on analyzing how product reputation influences consumers' buying decisions. Based on this, the article selects January 13, 2023, the date of Japan's announcement of its nuclear contamination discharge policy, as a crucial point, and collects sales data of seafood products produced in Japan from the HKTV website for the week before and after the announcement for analysis.

In terms of variable selection, this article uses sales (quantity) as the dependent variable and the policy variable as the core explanatory variable, constructing a multiple regression model. To control the interference of time effects on policy impacts, this article specifically considers the order time variable to eliminate temporal volatility. Additionally, to eliminate the potential influence of the time trend on the research results, this article introduces seafood products from European countries as a control group, thereby enhancing the accuracy and reliability of the research findings.

The results of regression demonstrate that the sales of Japanese seafood products decreased significantly after the policy announcement, indicating that consumers' willingness to purchase Japanese seafood products was negatively affected, which offers insights for enterprises. Governmental actions in Japan have violated ESG standards, thereby influencing consumer choices. Similarly, any corporate behavior that violated ESG standards may also impact corporate reputation and, consequently, consumer choices. Therefore, enterprises should attach importance to their image and conduct. Beyond ensuring product quality, they should actively shoulder social responsibilities, adhere to ESG principles, safeguard their reputation, and establish consumer trust. Besides, this article also finds that consumers' purchasing habits are affected by circadian rhythms. They may be less sensitive to the policy change of Japan's announcement of nuclear-contaminated water discharge policy at night. Their impulsive consumption behaviors provide some inspiration for e-commerce platforms. They can increase personalized recommendations to consumers at night. They can also launch activities such as limited-time discounts and night-time special promotions to stimulate consumption.

In summary, the announcement of Japan's nuclear-contaminated water discharge policy not only poses a threat to the environment and human health, but also has impacts on consumer trust and purchasing willingness. This event indicates the impact of government policies on consumer behavior and the importance of product reputation. In the future, With the popularization of the ESG concept, governments and corporations need to pay more attention to the long-term impacts of their decisions, and actively take responsibility for protecting the environment.

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