Geopolitical Environmental Events and Consumer Behavior: A Regression Analysis Based on the Hong Kong Market

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Abstract. In recent years, frequent geopolitical and environmental emergencies have profoundly impacted regional consumer markets and purchasing decisions. Using Japan's nuclear-contaminated water discharge announcement as a quasi-natural experiment, this study examines its effects on Hong Kong consumers' behavior. Employing regression analysis as the primary empirical method, we construct models to analyze shifts in consumer attitudes, purchase intentions, and consumption choices during environmental emergencies. The findings demonstrate that the announcement significantly influenced local consumers' risk perception and purchasing behaviors, leading to marked adjustments in product preferences. These conclusions not only enrich empirical research on geopolitical events and consumer behavior but also provide actionable insights for businesses, marketers, and relevant authorities in managing public emergencies.

Keywords: Geopolitical environmental events; Discharge of nuclear wastewater; Consumer behavior; Regression analysis; Hong Kong consumers

1 Introduction

1.1 Research Background and Motivation

In the context of globalization and evolving geopolitical dynamics, geo-environmental events have become pivotal factors influencing regional economies, market order, and consumer decision-making. Emergencies centered on environmental pollution and ecological security—characterized by rapid transmission, wide-ranging impacts, and heightened public awareness—exert more sudden and contagious effects on consumer markets. These events directly reshape consumers 'risk perceptions, attitudes, and purchasing behaviors. The Japanese nuclear wastewater discharge incident, a quintessential geo-environmental emergency, sparked global debates on ecological and food safety while significantly disrupting neighboring markets. As a highly open international consumer hub, Hong Kong maintains close trade ties with Japan in food, cosmetics, and daily necessities. Given consumers' heightened sensitivity to food safety and environmental risks, the incident swiftly ignited widespread societal concern. This

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led to fluctuating trust in Japanese imports—particularly food and aquatic products—and marked a noticeable shift in consumer behavior.

This study focuses on the case and Japan as research subjects, highlighting their typicality and irreplaceability. Firstly, the incident aligns with the scope of research on geopolitical environmental emergencies, providing a high-quality sample for analyzing consumption fluctuations caused by non-product quality issues. Its impact directly affects regions like Hong Kong, which are highly trade-integrated and sensitive. Secondly, since Japan has only issued an announcement without yet releasing the product into the sea, the quality of Japanese exports to Hong Kong remains unchanged. This indicates that the consumption fluctuations stem from a government trust crisis, allowing the study to isolate quality-related factors and focus on core research objectives. Thirdly, in terms of research subject selection, Japan's uniqueness lies in the government's credibility-deficient actions, with a clear logical chain of research. Moreover, Hong Kong's consumption behavior serves as a robust and irreplaceable sample.

1.2 Literature Review and Related Research

In terms of the transmission mechanism of geopolitical risks, scholars have also conducted multi-angle discussions. Li Yong [1] studied the relationship between political risk, risk perception, and corporate overseas investment, finding that corporate risk perception has an inverted U-shaped moderating effect on the relationship between political risk and overseas direct investment (ODI) decisions, and the magnitude of the moderating effect varies with industry and corporate attributes. At the financial market level, Zhu Yanli and Deng Jiajia [2] used a smoothed transition vector autoregression model, treating geopolitical risks as a regime change variable, to explore the asymmetric contagion effect of tail risks across industries in China's stock market. They found that geopolitical risks significantly enhance the contagion effect of tail risks, with the energy and materials industries serving as stable net spill-overs of risks under different regimes. This indicates that geopolitical risks can exert direct and asymmetric shocks on financial markets through market sentiment and investor behavior.

Recent studies have further expanded the scope of geopolitical risks. Wang Feng et al. [3] found that geopolitical risks significantly negatively impact climate change adaptation, with high greenhouse gas emissions and low renewable energy use in countries being more affected, primarily through reduced adaptation readiness. Ma Jie et al. [4] analyzed the impact of international geopolitical trends on China's natural gas supply and demand, revealing the direct effects of geopolitical events on the supply-demand balance of specific commodity markets. These studies provide multi-angle evidence for understanding the broad impacts of geopolitical risks.

The impact of geopolitical events on consumer behavior stands as a central focus of this study. Consumers adopt distinct coping strategies when facing risks. A study by Auruskeviciene et al. [5] on Lithuanian consumers revealed that geopolitical uncertainty influences conservative spending behaviors through threat and coping assessments, offering insights into how individual psychological responses and resilience contribute to economic stability. Arning and Venghaus [6] conducted a German survey showing that sustainable travel choices remained stable during crises, while ener-

gy-saving and shopping habits exhibited fluctuations. The research identified four distinct sustainable behavior patterns, underscoring the importance of considering both behavioral domains and individual factors.

Environmental risk perception refers to consumers' subjective assessment of potential hazards from environmental incidents, which largely determines their responses. Meng Bo et al. [7] clarified the importance of risk perception through literature synthesis and constructed a theoretical model, highlighting the significant impact of emotional factors on individual attitude fluctuations. Wahdat and Lusk [8] investigated determinants of consumer hoarding behavior, finding that increased fixed costs and price declines significantly enhance hoarding, while purchase restrictions reduce it. Their follow-up study [9], using Hurricane Ian as a case, revealed substantial hoarding in Florida's food and beverage categories, accompanied by changes in credit card spending patterns, demonstrating the immediate impact of extreme weather events on consumer behavior. Liu et al. [10] examined consumers 'online food safety self-protection behaviors during the COVID-19 pandemic, discovering that risk perception significantly positively influenced protective behaviors, with satisfaction with online retailers' safety management performance significantly moderating risk perception. Zhu and Jiang [11] analyzed joint selection behaviors of fresh food purchasing channels and terminal delivery services during major public health events, finding that consumers first adjusted their attitudes toward e-commerce, preferring community group purchases, prioritizing convenience, and showing higher trust in personnel protective measures. These studies collectively indicate that crisis events prompt consumers to reassess risks, adjust shopping channels, product preferences, and consumption patterns.

Social conflicts and political events can significantly influence consumers 'daily choices. Iris Gavish[12] examined how the October 7th events in Israel altered the priority order of food choices among consumers, revealing that post-war sentiment, convenience, and affordability gained greater importance, while health, aroma, texture, and taste became less significant. Khairullah and Karmagatri[13] analyzed Indonesian consumers' boycott of McDonald's during the 2023 Israel-Palestine conflict, finding that most consumers held negative attitudes toward the chain, influenced by political, cultural, and religious factors.

Furthermore, Goor et al. [14] introduced the concept of "historicizing the present," emphasizing the historical significance of current events. This approach has been applied in marketing by both for-profit and non-profit organizations, with research exploring its psychological impact on consumer behavior. Kruger et al. [15] conducted a longitudinal study on consumer hostility following the U.S. presidential election, revealing a significant decline in hostility and increased willingness to purchase American products, demonstrating that political events influence purchasing behavior through contextual factors. In the context of the Russia-Ukraine war, Obada et al. [16] utilized the Social-Organizational-Research (SOR) model to evaluate how social media usage, war-related fear, green values, perceived quality, enjoyment of use, and product image affect the purchase intention for recycled electronics. Their findings indicated that war-related fear enhances product image perception, thereby increasing purchase intent. These studies collectively demonstrate how geopolitical events directly shape

consumer attitudes, preferences, and purchasing decisions through complex psychological and social mechanisms.

1.3 Overview of the Research Framework

This study examines the impact of Japan's nuclear wastewater discharge announcement on Hong Kong consumers' risk perception and decision-making through a logical analytical framework. The research begins by reviewing relevant literature and formulating hypotheses tailored to Hong Kong's market characteristics. Data collection and processing are conducted to establish variables, with purchase volume as the dependent variable and Japan's origin, pre-event/post-event factors, and interaction terms as core independent variables. A multiple linear regression model is employed to empirically test the effects of Japan's origin as the treatment group, analyzing the influence of core and control variables. The study concludes by interpreting behavioral patterns of Hong Kong consumers based on regression results, deriving practical recommendations for corporate strategies, marketing approaches, and regulatory frameworks. Finally, it outlines research limitations and future directions, aiming to provide empirical insights for consumer decision-making in uncertain environments.

2 Data Sources and Data Introduction

First, the regression analysis in this study utilized authentic consumption data from HKTVmall, the core e-commerce platform operated by Hong Kong Television Broadcasts Limited. The dataset encompassed user spending amounts, order details, product category distribution, average transaction value, and consumption behavior patterns, spanning from December 1, 2022 to February 28,2023. This timeframe covers the critical window period before and after Japan's announcement of nuclear wastewater discharge (with the official declaration date being January 13,2023), providing a precise empirical setting for examining the impact of geopolitical events on consumer behavior. Second, after data cleaning that removed missing values, abnormal transactions, and invalid records, 416,355 valid observation samples were retained.The particulars of the variables are shown in Table 1. The sample size met the statistical requirements for large-sample regression analysis and covered multiple categories including food, fresh produce, and daily necessities, effectively reflecting changes in Hong Kong consumers' purchasing decisions before and after the event. Finally, the regression model in this study used product purchase quantity (quantity) as the dependent variable to analyze the influence of various factors on consumer purchasing behavior. Japan was designated as the core treatment group in the model, which included multiple markets from the United States, Australia, South Africa, Spain, Canada, Norway, the United Kingdom, and Germany. Since this study focused on the impact of a specific policy or event in Japan, these markets were not directly affected by the event and served as control groups. This setup allowed for comparative analysis of regional differences and post-policy intervention changes by contrasting them with other markets.

Table 1. The list of variables

Notation	Variable explanation
const	intercept term of regression model
discount_mean	Average order discount
cash_voucher_applied_value	Actual cash coupon amount used in the order
price	Unit price of the order item
weight	The weight of the goods
Japan	Product origin dummy variable: 1 = product origin is Japan, 0 = product origin is not Japan
After	Policy time dummy variable: 1 = after the announcement of Japan's nuclear wastewater discharge, 0 = before the event
Japan*After	Core Interaction Terms: Cross Effect of "Japan Origin" and "After the Discharge of Nuclear Wastewater"
non-standard-delivery	Delivery method dummy variable: 1 = HKTV non-standard delivery service, 0 = standard delivery service
frozen foods	Product category dummy variable: 1 = frozen food, 0 = non-frozen food
fruits, vegetables, flowers	Product category dummy variable: 1 = fruits, vegetables, and flowers; 0 = other products
weekend_effect	Time dummy variable: 1 = order placed on a weekend (Saturday or Sunday), 0 = order placed on a weekday
month_1	Fixed effect dummy variable for month: 1 = order occurred in January, 0 = other months
month_2	Fixed effect dummy variable for month: 1 = order placed in February, 0 = other months
month_12	Fixed effect dummy variable for month: 1 = order placed in December, 0 = other months
Japan*After*price	triple interaction term

3 Regression Analysis

3.1 Multiple Linear Regression Model

This study employs multiple regression analysis to examine the impact of various factors on sales volume. The statistical method evaluates the relationship between the dependent variable (sales quantity) and multiple independent variables, including average discount rates, cash voucher usage amounts, and product weights. Through analysis, we identify factors with statistically significant effects on sales volume, as well as those with no significant impact. Therefore, this study adopts a multiple linear regression model to quantify the influence of these variables on sales. The regression coefficients measure the degree of impact of each variable, while P-values determine the statistical significance of these effects. To investigate the influence of Japan's nuclear-contaminated water discharge incident on Hong Kong consumers' purchasing behavior, the following multiple linear regression model was constructed:

$$Purchase_{lit}=\alpha_i+\beta_1\times After_t+\beta_2\times Japan_{li}+\beta_3\times(Japan\times After)_{lit}+\beta_4\times(Japan\times After\times price)_{lit}+\mathbf{X}_{lit}\gamma+\epsilon_{lit},$$

Where,

$Purchase_{lit}$: Purchase behavior (purchase amount or purchase willingness) for product l, order i, and period t

α_i: Individual fixed effects (e.g., product or store fixed effects)

$After_t$: Time dummy variable that equals 1 if period t is after the Fukushima wastewater discharge event, and 0 otherwise

$Japan_{li}$: Product origin dummy variable that equals 1 if product l is from Japan, and 0 otherwise

$(Japan\times After)_{lit}$: Core interaction term capturing the additional effect of Japanese products after the event

$(Japan\times After\times price)_{lit}$: Triple interaction term measuring the marginal effect of price changes for Japanese products after the event

$X_{lit}\gamma$: Linear combination of control variables, including:

- Price and promotions: price, discount_mean, cash_voucher_applied_value
- Product attributes: weight, frozen foods, fruits, vegetables, flowers
- Delivery method: non-standard delivery
- Time effects: weekend_effect, month1, month2, month12

ϵ_{lit}: Random error term

3.2 Regression Results

Table 2 presents the regression analysis results, revealing several statistically significant factors affecting sales volume.

Table 2. The regression results

Variables	coef	P>|t|
const	2.774	0.000
discount_mean	0.0009	0.000
cash_voucher_applied_value	0.0032	0.000
price	-0.0033	0.000
weight	-0.001	0.000
Japan	-0.0323	0.039
After	0.0189	0.396
Japan*After	-0.0252	0.403
non-standard-delivery	0.8273	0.001
frozen foods	0.354	0.000
fruits,vegetables,flowers	1.3597	0.000
weekend_effect	-0.1394	0.000
month_1	0.8989	0.000
month_2	0.9484	0.000
month_12	0.9268	0.000
Japan*After*price	-0.0014	0.000

First, the constant term shows a strong positive baseline (2.7740, $p<0.001$), indicating that product sales typically maintain a substantial base level even in the absence of other variables. This suggests that inherent market demand and industry baseline play a pivotal role in driving sales performance.

Furthermore, factors such as average discount (discount_mean), cash voucher applied value (cash_voucher_applied_value), delivery mode (delivery_mode_hktv-non-standard-delivery), specific product subcategories (e.g., frozen/quick-frozen foods, fruits, vegetables, and flowers), and specific months (month_1, month_2, month_12) all exhibit significant positive correlations with sales performance. The positive impact of average discounts and cash voucher applied values likely stems from price incentives effectively stimulating consumer purchasing intent. The positive effect of specific delivery modes may reflect their advantages in timeliness or convenience. The significant positive correlation in certain food categories highlights consumers' stable demand for fresh and frozen products. Year-end and early-year consumption surges demonstrate how seasonal demand drives sales growth. In summary, well-designed promotional strategies, effective payment discounts, specialized delivery services, and market demand for specific product categories collectively contribute to enhancing overall sales performance.

On the other hand, certain factors exerted negative impacts on sales. For instance, products originating from Japan (Japan) showed significantly lower sales ($p<0.05$), which may reflect consumer concerns or resistance toward Japanese-originated goods following the nuclear-contaminated water discharge announcement. The unit price (total_price_mean), product weight (weight), weekend effect (weekend_effect), and interaction term (Japan*After*price) also exhibited negative correlations with sales, indicating that higher prices and heavier products might have suppressed purchasing decisions. The relatively weaker weekend consumption demand could be attributed to consumers 'preference for offline shopping over weekdays. The significant negative coefficient of Japan*After*price further demonstrates that the higher the price of Japanese-originated products, the more severe the post-disaster consumption impact. This suggests that the price suppression effect of Japanese products on sales was significantly amplified after the incident. Consumers' resistance to high-priced Japanese products was particularly intense, reflecting a sharp decline in trust in such items and a dramatic increase in price sensitivity. Notably, the quality of Japanese exports to Hong Kong showed no objective changes before and after the event, yet their sales experienced dramatic fluctuations. This phenomenon clearly indicates that market volatility was not caused by product defects but rather driven by the subjective trust crisis triggered by the nuclear-contaminated water discharge announcement. In the background of stable objective risk, the collapse of consumer trust in the government becomes the core variable of the dominant consumption behavior, which eventually leads to the collective avoidance behavior of Japanese goods.

4 Conclusion

This study demonstrates that the geopolitical environmental risks stemming from Japan's nuclear wastewater discharge announcement have significantly reshaped Hong Kong consumers' risk perception and purchasing decisions, directly causing a sharp decline in sales of Japanese-origin products in Hong Kong. This finding clearly illustrates that when a nation's major decisions diverge from global ESG core principles, geopolitical environmental emergencies can rapidly propagate through consumer behavior, generating substantial impacts on regional markets.

From the consumer perspective, the ESG concept has become deeply embedded in purchasing decision-making. Consumers now prioritize not only product pricing and quality but also the environmental accountability and governance credibility of manufacturing countries as key evaluation criteria. For businesses, integrating ESG-related geopolitical risks into core strategies is imperative. They should actively diversify supply chains and implement risk mitigation measures, particularly for high-environmental-risk and highly sensitive product categories, by promptly expanding alternative supply channels and establishing secure alternative supply systems. At the governmental level, strengthening ESG governance and emergency management is essential. Regulatory authorities must establish rapid-response mechanisms for authoritative information dissemination during crises, enhance import product traceability systems, and reinforce market oversight to maintain fair competition. Cross-departmental collaboration in public education initiatives should also be prioritized to stabilize consumer confidence.

Globally, this research offers profound universal insights: In an era where ESG has become the core consensus of global governance, no nation's development decisions can be divorced from environmental responsibility and international ethics. Violations of ESG principles will not only trigger a chain reaction of consumer boycotts but also undermine national credibility and reshape the global trade landscape. For all countries, only by integrating ESG principles into national governance and development strategies, upholding environmental responsibilities, and practicing global consensus can they earn trust in international markets and achieve synergistic win-win outcomes between economic development and global governance.

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