Economic Consequences After Tragedy Strikes: Evidence from the Itaewon Crowd Crush

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Abstract

This study investigates the economic repercussions of the Itaewon crowd crush that occurred in Seoul, South Korea. Following the event, there was a significant decline in card spending, transaction counts, and foot traffic; the effects on adjacent areas were less pronounced. Although there was a gradual recovery during the two months following the incident, the local economy did not return to its pre-incident status. The study elucidates the underlying mechanism of consumption reduction through changes in foot traffic, serving as a direct measure of individuals' risk-aversion behavior. The working-age population and non-local residents were the main causes of the decreased foot traffic, according to analysis by demographic groups, suggesting their increased sensitivity to perceived threats. Moreover, non-discretionary sectors including education and healthcare were less affected than tourism-related sectors including restaurants and travel.

Keywords: Consumer behavior, Foot traffic, Risk avoidance, Card transaction data

JEL Codes: D12, D81, R23

1 Introduction

Safety risks, such as terrorism and natural disasters, pose threats to people's lives and safety. Over the past few decades, there were some major accidents such as 9/11 attacks, the Boston Marathon Bombing, and Hurricane Katrina that claimed hundreds of people's lives and devastated the victimized area. Given that these events persist and incur unexpected economic costs, it is necessary to investigate the economic consequences of these tragedies.

In this study, I examined how a tragic event that claimed many lives affected the local economy through the case of the Itaewon crowd crush. This event happened in October 2022 at the Itaewon 1-dong[1], Seoul, South Korea. The Itaewon neighborhood is one of Seoul's major tourist attractions. After governmental restrictions on COVID-19 were eased, an excessive number of people visited the area during the Halloween period in 2022, leading to a tragic crowd crush incident. 159 people were killed, and 196 others were injured, and this is the largest mass casualty incident in Seoul since the Sampoong Department Store collapse in 1995.

The Itaewon crowd crush provides a unique environment for two reasons. First, it was an unexpected scale of accident that occurred at the central area of Seoul. The Itaewon area, one of Seoul's representative tourist attractions, experienced an unprecedented large-scale crowd accident crush accident for the first time in Korean history. Second, publicly available data from the Seoul Metropolitan Government provides detailed information on consumption and foot traffic records. This allows me to explore how people adjusted their behavior over time after the tragedy, and which factors are the driving forces that contribute to stronger effects.

For the empirical framework, I first analyze how card spending changes after the Itaewon crowd crush using the difference-in-differences (DID) model. Next, I use the event study method to explore the dynamic effects of the Itaewon crowd crush. I also implement some robustness checks such as permutation tests and sensitivity tests following Rambachan and

[1]Dong is the smallest administrative unit in Seoul, South Korea.

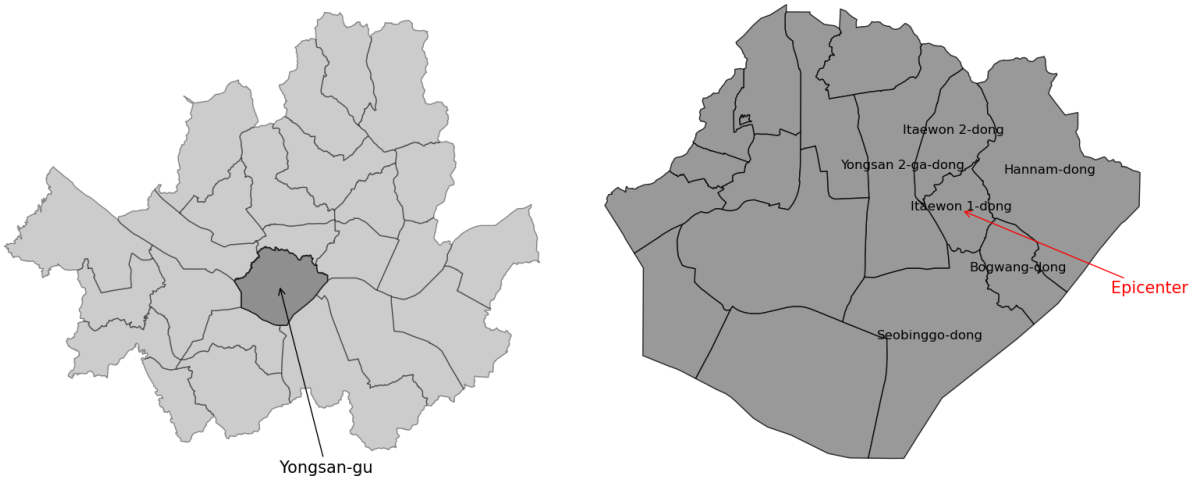

Figure 1: Maps of Seoul and Yongsan-gu

Notes: Seoul is comprised of 25 administrative districts (gu). The Itaewon neighborhood, situated in Yongsan-gu, is composed of several sub-districts (dong). Itaewon 1-dong is centrally located, surrounded by Itaewon 2-dong, Yongsan 2-ga-dong, Seobinggo-dong, Bogwang-dong, and Hannam-dong.

Roth (2023) to address potential identification threats when using these methods. Finally, I also utilize a recently suggested method from Arkhangelsky et al. (2021) that combines powerful traits of the DID and the synthetic control-based methods.

The results showed that the Itaewon crowd crush significantly negatively impacted card consumption, transaction counts, and foot traffic in Itaewon 1-dong. While there was some recovery in consumption and foot traffic over time, they had not returned to their pre-incident levels by the end of 2022. On the other hand, adjacent areas of Itaewon 1-dong experienced less precise impacts, which indicates that the tragic event showed a localized effect. Moreover, there were more pronounced effects on sectors that are relatively more discretionary and related to tourism. Finally, the impact on foot traffic varied significantly by age group and residential area, with the effects concentrated on the working-age population and individuals residing outside of Yongsan district, where Itaewon is located. I also provide test results that validate my findings under possible violations of the parallel trends assumption.

This study contributes to the literature on the economic consequences of tragic events in several ways. Previous studies have focused on the impact of such events on various variables like mental health (Clark et al., 2020) and educational attainment (Cabral et al., 2021). Regarding economic consequences, some papers have examined outcomes such as private consumption, private investment (Llussá and Tavares, 2011) and employment and earnings (Brodeur and Yousaf, 2022). While Llussá and Tavares (2011) focused on the national-level effects of terrorist attacks, they did not investigate local-level effects or the dynamic recovery of consumption over time. In contrast, this study directly examines the recovery of consumption activities and identifies which consumption sectors are more affected by such events. To describe the potential mechanisms of decreased labor market outcomes, Brodeur (2018) utilized survey data measuring emotional status such as consumer pessimism and safety concerns. However, self- reported responses from surveys are prone to reporting bias and may underrepresent emotional severity. To address this challenge, this study measures individuals' revealed risk preferences through foot traffic data. Additionally, detailed individual-level characteristics in foot traffic data enable elucidation of potential mechanisms in risk aversion behavior.

The remainder of this paper is constructed as follows: Section 2 provides a detailed background of the Itaewon crowd crush and its context. Section 3 describes the data and methodology employed in this study. Section 4 presents the empirical results and their interpretations. Finally, Section 5 concludes.

2 Data

I compiled data sources of card spending and foot traffic to construct a balanced panel of dong-by-week observations from week 17 to 51 in 2022 for all dongs in Seoul, South Korea. I provide more details on each data source below:

2.1 Card Transaction

I use estimates of card transaction data that encompasses all offline transaction records in Seoul. This dataset is provided from Shinhan Card, which is the Korea's largest credit card company with a 22% market share. The record includes both personal (credit and debit) and corporate card usage for domestic users, while for foreign users, it covers their card usage records. Using the record, total card spending and transaction counts in each block are estimated using a methodology that utilizes the company's market share, individual card usage patterns, and other demographic factors.

The data is aggregated at various levels: for domestic users, card spending, and transaction counts are compiled for 63 industries at the block level by hour, and at the district level by day by gender and age group. For foreign users, the data covers 56 industries, aggregated at the block level by hour, and district level by country of origin. Certain types of transaction records are excluded, such as online transactions, taxes, public charges, telecommunication fees, insurance fees, and university tuition fees for both domestic and foreign users, with additional exclusions for foreign users including household services and education fees. For this analysis, I selected domestic user records estimated at the block level by hour.

2.2 Foot Traffic

The foot traffic data consists of hourly estimates generated using telephone signal data from KT, the second-largest mobile telecom company in South Korea with a 26% market share. This dataset provides information on both domestic residents and long-term foreign visitors engaged in various activities such as commuting, shopping, and tourism at specific times and locations in Seoul. The data includes demographic details like residential area, gender, and age groups (from 10 to 79 years old, in 5-year intervals). To ensure privacy, the dataset employs de-identification measures, omitting records where the number of people moving by gender/age in a specific hour is less than three. I accessed this data through a web page called the Open Data Square, managed by the Seoul Metropolitan City Government. For

this analysis, the raw hourly data has been aggregated to a weekly level, and records for foreigners were excluded.

2.3 Descriptive Statistics

Table 1 provides summary statistics for the main variables. The average total card spending per dong in Seoul is 5.622 billion won, which is equivalent to 4.08 million US dollars. This indicates that the weekly total spending per neighborhood is 4.08 million dollars. The average transaction count is 170,000, suggesting that, on average, 170,000 card transactions occur weekly in each dong. Finally, the average foot traffic is 1.174 million, implying that 1.174 million people pass through each dong in Seoul per week.

Table 1: Summary Statistics

Variables	Mean	SD	Min	Max
Card Spending	5.622	9.426	0.007	187.643
Transaction Counts	0.170	0.786	0.000	1.687
Foot Traffic	1.174	0.786	0.111	6.705
Observations		14,840		

Notes: Table 1 reports summary statistics of card spending, transaction counts, and foot traffic provided by Seoul Metropolitan Government.

3 Empirical Framework

In this study, I investigate the economic effects of the Itaewon crowd crush by using multiple estimation methods. I first assign the Itaewon 1-dong as the treatment unit to identify the economic impact of Itaewon 1-dong, the epicenter of the Itaewon crowd crush. To exclude any spillover effects into adjacent areas, I exclude the five dongs surrounding Itaewon 1-dong and use the remaining dongs in Seoul as the control group. Next, I define the five adjacent dongs that surround Itaewon 1-dong as another treatment group to estimate the effects in the areas surrounding Itaewon 1-dong. Identifying the effects for these units enables me

to compare the direct impact on the epicenter and any spillover effects on the neighboring areas. For this analysis, the control group consists of all other dongs in Seoul, excluding Itaewon 1-dong.

3.1 Difference-in-Differences

The main empirical specification in this paper is a two-way fixed-effect (TWFE) difference-in-differences (DID) regression:

$$Y_{it} = \beta \cdot \text{PostTreat}_{it} + \delta_i + \gamma_t + \epsilon_{it} \tag{1}$$

where Y_{it} corresponds to the card spending, transaction counts, and foot traffic of dong $i$in week t; $PostTreat_{it}$ is an indicator variable equal to one when i is a treatment unit and t is after the event and zero otherwise; δ_i is the dong fixed effect; γ_t is the week fixed effect; ϵ_{it} is the error term. The parameter of the interest is the coefficient β. I use cluster-robust standard errors at dong-level throughout the analysis.

However, when the number of groups is small, clustered-robust standard errors are systematically biased downwards and can result in the over-rejection of the null hypothesis . To address this concern, I conduct permutation tests when the treatment unit is Itaewon 1-dong only. I assigned fake treatments to all the other dongs in Seoul except Itaewon 1-dong and five adjacent dongs of Itaewon 1-dong and calculated placebo estimates of β. This allows me to obtain an empirical p-value by calculating a proportion of estimates that have a test statistic greater than that of the estimate in our actual treatment unit.

3.2 Event Study Method

Beyond analyzing the overall impact of the Itaewon crowd crush during the post-treatment period, it is crucial to observe how the negative shock in the victimized area evolves. To investigate the dynamic effects of the Itaewon crowd crush, I utilize the following event study

method estimation model:

$$Y_{it} = \sum_{k=17, k\neq 42}^{51} \beta_k 1[\text{week}_t = k] 1[\text{Treat}_i = 1] + \delta_i + \gamma_t + \epsilon_{it} \tag{2}$$

In the equation (2), $1[\text{week}_t = k]$ denotes 1 if the week number is k and zero otherwise; $1[\text{Treat}_i = 1]$ denotes 1 for the treatment unit and zero otherwise. I set $t = 42$ as the reference point since the Itaewon crowd crush occurred during week 43.

Moreover, I check the robustness of the estimation results by employing an approach following Rambachan and Roth (2023). I allowed the violation of the parallel trends assumption by bounding the worst-case post-treatment difference in trends into $\bar{M}$ times the equivalent maximum value in the pre-treatment period. Additionally, I conduct sensitivity tests by calculating 95% confidence intervals for the main estimates under different values of $\bar{M}$. These sensitivity analyses help assess the robustness of the results when the parallel trends assumption is relaxed and identify the breakdown value of $\bar{M}$, where the null hypothesis can no longer be rejected.

3.3 Synthetic Difference-in-Differences

Another stream of approach to overcome the potential violation of the parallel trends assumption is synthetic control (SC) based methods, proposed by Abadie et al. (2010). While these methods can flexibly weight control units to match their pre-exposure trends to those of the treated, they are prone to time-varying unobserved confounders and have difficulties in conducting statistical inference. To address these concerns, Arkhangelsky et al. (2021) propose a novel method called "Synthetic difference-in-differences (SC-DID)" that integrates attractive features of the DID and synthetic control approaches. By explicitly considering unit-specific weights $\hat{\omega}_{sdid}$ and time-specific weights $\hat{\lambda}_{sdid}$ in equation (3), this method can emphasize control units that are on average similar to the treatment unit and emphasize time periods that are on average similar to the post-periods.

$$(\hat{\beta}_{sdid}, \hat{\mu}, \hat{\delta}, \hat{\gamma}) = \text{argmin} \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \delta_i - \gamma_t - W_{it}\beta)^2 \hat{\omega}_{sdid} \hat{\lambda}_{sdid} \tag{3}$$

Estimating the parameter of interest $\hat{\beta}_{sdid}$ takes following procedures: (1) compute a regularization parameter ζ, (2) compute unit weights via (1), (3) Compute time weights, (4) compute $\hat{\beta}_{sdid}$ with the equation (3). In essence, the SC-DID emphasizes units that are on average similar in terms of their past to the treated units and periods that are on average analogous with the treated periods or post-periods.

4 Results

In this section, I present the findings on the economic consequences of the Itaewon crowd crush using the empirical framework explained in Section 3. The results are organized to provide the overall effect, dynamic effect, heterogeneous effects on card spending, transaction counts, and foot traffic, and test results as robustness checks.

4.1 Overall Effect

Table 2 shows the overall effect of the Itaewon crowd crush on economic activities during the post-period, estimated by equations (1) and (3). Panel A shows the DID estimates and the SC-DID estimates for Itaewon 1-dong. They indicate a sharp decline in card spending by 51%, transaction counts by 59%, and foot traffic by 14% compared to their average value. Those results were all statistically significant at the 1% level, and the SC-DID model showed similar results.

In panel B, consumption spending, transaction counts, and foot traffic decreased for the five adjacent dongs near Itaewon 1-dong. However, the adjacent dongs experienced modest effects compared to Itaewon 1-dong, with their relative effects less than 10%. In the DID method, estimates for card spending and foot traffic were statistically significant at 5% level. For the case of the SC-DID method, the results were similar, but showed lower statistical

Table 2: Effects of the Itaewon crowd crush in Itaewon1-dong and its adjacent areas

	Card Spending		Transaction Counts		Foot Traffic	
	(1)	(2)	(1)	(2)	(1)	(2)
Panel A. Itaewon 1-dong						
Estimate (s.e.)	-2.8669***	-2.9752***	-0.1005***	-0.0906***	-0.1676***	-0.1822***
	(0.0573)	(0.6479)	(0.0006)	(0.0058)	(0.0031)	(0.04605)
Dependent Variable mean	5.6396	5.6396	0.1707	0.1707	1.1787	1.1787
Effect relative to mean, percent	-50.8347	-52.7520	-58.8884	-53.3099	-14.2177	-14.2190
Panel B. Adjacent areas of Itaewon 1-dong						
Estimate (s.e.)	-0.2162**	-0.2679	-0.0107*	-0.0056*	-0.0244**	-0.0276
	(0.0852)	(0.2646)	(0.0059)	(0.0030)	(0.0105)	(0.0203)
Dependent Variable mean	5.6206	5.6206	0.1699	0.1699	1.175	1.175
Effect relative to mean, percent	-3.8468	-4.7664	-6.3025	-3.2961	-2.0799	-2.3489

Notes: Estimates of equation (1) and (3) from the main text. Specification (1) refers to the Difference-in-differences estimation, and Specification (2) refers to the Synthetic Difference-in-differences estimation. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

significance.

The results suggest the substantial localized economic disruption occurred by the Itaewon crowd crush, with the most severe effects concentrated at the epicenter of the accident. In addition, both Itaewon 1-dong and its adjacent areas experienced a greater decrease in card spending and transaction counts compared to the reduction in foot traffic. This result implies that while there was a decrease in foot traffic in the Itaewon neighborhood after the incident, there was also an additional reduction in card spending and transactions among those who visited the area after the incident.

4.2 Dynamic Effect

Figures 2 and 3 illustrate the dynamic impact of the Itaewon crowd crush on economic activities, with black shaded areas representing 95% confidence intervals for each estimate. I also provide estimation results for all coefficients in Table E. In Itaewon 1-dong, the strongest effect was observed in week 44, which is one week after the incident. For example, compared to week 42, card spending in week 44 decreased by 4.7 billion won (approximately 3.4 million US dollars), which is almost a 90% decline compared to its mean. Although there was a

gradual recovery after week 44, the negative effect did not rebound to its original level by week 51.

For the adjacent dongs of Itaewon 1-dong, card spending initially showed a negative trend but increased around week 50, though most of these changes were not statistically significant. Transaction counts exhibited a negative but statistically insignificant effect, while foot traffic demonstrated a significant decrease in the first few weeks following the incident.

4.3 Heterogeneous Effects on Card Spending and Transaction Counts by Consumption Sectors

Table C presents the analysis results of card spending and transaction counts by consumption sector using equation (1). While almost every sector showed statistically significant decreases at 0.05 level in card spending and transaction counts, the decline was particularly pronounced in tourism-related sectors such as restaurants and travel. For example, in restaurant and bar sector, card spending decreased by 155% relative to the mean and transaction counts by 117%. Travel sector also experienced a substantial decrease, with a 45% decline in card spending and a 331% drop in transaction counts. This suggests that there was a significant reduction in visitors who primarily came to the Itaewon area for tourism related purposes. Furthermore, there were relatively less stronger impacts on non-discretionary sectors such as food and beverages, education, and medical care.

4.4 Heterogeneous Effects on Foot Traffic by Individual Characteristics

Foot traffic data provides hourly values for visitors to specific areas, categorized by age group, sex, and residential district. Utilizing this detailed information, I calculated foot traffic values based on age group, sex, and whether movement was within or outside the residential district. I then used equation (1) to determine which groups primarily drove the decrease in

Table 3: Effects of the Itaewon crowd crush in Itaewon 1-dong: By age group, sex, and movement type

Panel A: Age group	Children (10~19)	Working age (20~64)	Elderly (65~)
Estimate (s.e)	-0.0078*** (0.0006)	-0.1434*** (0.0023)	-0.0045*** (0.0004)
Dependent variable mean	0.1101	0.8408	0.1359
Effect relative to mean, percent	-7.1108	-17.0592	-3.2936
Panel B: Sex	Male	Female	
Estimate (s.e)	-0.0717*** (0.0014)	-0.0841*** (0.0017)	
Dependent variable mean	0.5065	0.5803	
Effect relative to mean, percent	-14.1459	-14.49	
Panel C: Movement Type	Out of residential district	Within residential district	
Estimate (s.e)	-0.1370*** (0.0019)	-0.0306*** (0.0019)	
Dependent variable mean	0.5369	0.6419	
Effect relative to mean, percent	-25.5189	-4.7655	

Notes: Estimates of equation (1) of the main text. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

foot traffic in Itaewon 1-dong before and after the Itaewon crowd crush. According to Table 3, the decrease in foot traffic was primarily driven by the working-age population. After the Itaewon crowd crush, weekly foot traffic decreased by approximately 7,800 for children and 4,500 for the elderly, while the working-age population showed a significant decrease of about 143,400. This indicates that the working-age population accounted for most of the overall decrease. When examining the relative magnitude compared to the mean, the effect was strongest for the working-age population, with a decrease of about 17%.

One of the interesting point in this finding is that while previous literatures claimed that there is a general trend of decreasing risk preference with age (Deakin et al., 2004; Rolison et al., 2014), the revealed effect of risk-aversion the Itaewon incident, captured by the foot traffic, was strongest for the economically active population. Even considering the high proportion of the economically active population in foot traffic, the fact that this group showed the strongest reaction in terms of relative effect compared to the average is noteworthy. Both males and females showed similar decreases of about 14% compared to the average, indicating a homogeneous response across sexes in terms of avoiding the area.

Moreover, there was a larger decrease in movement from outside the residential district compared to movement within the residential district. Movement from outside the residential

district decreased by 25% compared to the average, while movement within the residential district decreased by only approximately 5% after the Itaewon incident. This suggests that people residing outside Yongsan district, the district containing Itaewon 1-dong, reacted more sensitively to the incident than those living within Yongsan district.

4.5 Robustness Checks

In this section, I provide the placebo test results obtained by estimating equation (1). I applied a fake treatment to the control group, which included all dongs in Seoul except the Itaewon 1-dong and its five adjacent dongs. This procedure yielded 418 placebo estimates of β. As shown in Figure 4, the estimates for Itaewon 1-dong demonstrated statistical significance at the 0.05 level for card spending, transaction counts, and foot traffic. This implies that the observed effects are unlikely to be driven by random chance. Also, I conducted sensitivity tests following Rambachan and Roth (2023). This test provides confidence intervals for the coefficient of $k = 44$ in equation (2), which is one week after the Itaewon crowd crush occurred. I tested over different values of $\bar{M} \in [0.5, 2]$, the factor that regulates the maximum deviation of post-trend deviation by which the maximum pre-trend deviation is multiplied. As shown in Figure 5, the sensitivity test results indicate that the findings are robust to violations up to 1.75 times the size of the largest deviation observed in the pre-period, with a "breakdown value" at $\bar{M} = 2$ for card spending and transaction counts. The breakdown vale for foot traffic was $\bar{M} = 1$.

5 Conclusion

This study examined the economic consequences of the Itaewon crowd crush in Seoul, South Korea, utilizing comprehensive card transaction and foot traffic data with detailed consumption sectors and demographic groups. The analysis revealed significant localized economic disruption in Itaewon 1-dong, evidenced by substantial reductions in card spending, transac-

tion counts, and foot traffic. The effects on Itaewon 1-dong were most pronounced immediately following the incident, showing a gradual recovery over time, though not fully returning to pre-incident levels. While adjacent areas also experienced some declines, the impact was less severe, indicating a concentrated economic effect at the incident's epicenter.

The study's findings highlight the vulnerability of certain consumption sectors and demographic groups to such tragic events. For example, tourism-related sectors, particularly restaurants and travel, were most severely affected, while non-discretionary sectors like education and medical care saw less impact. This underscores the sensitivity of discretionary spending to public safety concerns. Furthermore, the analysis of foot traffic data by demographic groups revealed that the working-age population and non-local residents exhibited the most significant decreases in visits, suggesting heightened sensitivity to safety concerns among these groups.

By examining risk-aversion behavior through changes in foot traffic, this research provides insights into the underlying mechanisms of consumption reduction following tragic events. Overall, this study contributes to understanding the localized economic consequences of tragic events by examining the risk-aversion behavior that influences economic activities and analyzing how economic damages recuperate over time.

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Figures and Tables

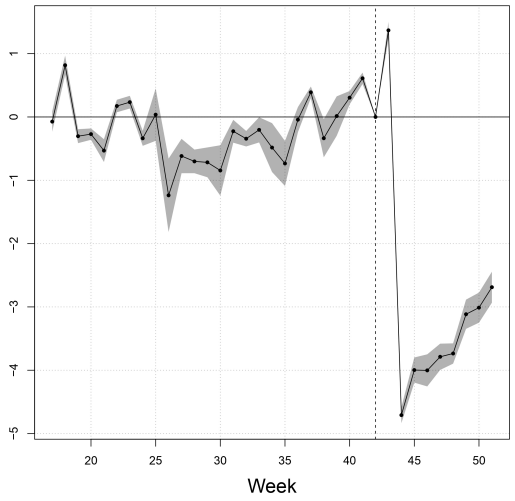
Table 4: Event study method estimates

	Card Spending		Transaction Counts		Foot Traffic	
	Itaewon 1-dong	Adjacent Areas	Itaewon 1-dong	Adjacent Areas	Itaewon 1-dong	Adjacent Areas
Week 43	1.369**	-0.1578*	0.0458***	0.0020	0.1294***	0.0246*
	(0.0689)	(0.0930)	(0.0003)	(0.0013)	(0.0016)	(0.0139)
Week 44	4.709**	-0.5327**	-0.1296**	-0.0098	-0.2242**	-0.0458**
	(0.0648)	(0.2092)	(0.0003)	(0.0067)	(0.0025)	(0.0157)
Week 45	-3.997**	-0.1656	-0.1197**	-0.0069*	-0.2241**	-0.0432**
	(0.1013)	(0.1616)	(0.0004)	(0.0040)	(0.0288)	(0.0080)
Week 46	4.002**	-0.4656***	-0.1118**	-0.0082*	-0.2102**	-0.0403**
	(0.1294)	(0.1405)	(0.0004)	(0.0043)	(0.0333)	(0.0131)
Week 47	-3.788**	-0.2765*	-0.1118**	-0.0068	-0.2140**	-0.0373**
	(0.1057)	(0.1534)	(0.0004)	(0.0049)	(0.0322)	(0.0111)
Week 48	3.736**	-0.5176**	-0.1087**	-0.0103**	-0.1921**	-0.0387**
	(0.0818)	(0.2617)	(0.0006)	(0.0055)	(0.0033)	(0.0106)
Week 49	3.116**	0.0231	-0.0994**	-0.0078**	-0.1693**	-0.0199
	(0.1177)	(0.3139)	(0.0005)	(0.0038)	(0.0034)	(0.0168)
Week 50	3.011**	-0.0360	-0.1010**	-0.0072	-0.1463**	-0.0165
	(0.1212)	(0.3300)	(0.0007)	(0.0049)	(0.0038)	(0.0214)
Week 51	-2.689**	0.3412	-0.0920**	-0.0043*	-0.1570**	-0.0357*
	(0.1248)	(0.8732)	(0.0012)	(0.0026)	(0.0040)	(0.0240)

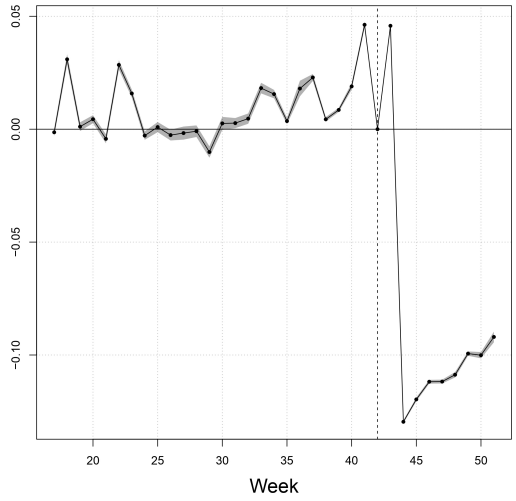
Notes: Estimates of equation (2) from the main text. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Table 5: Consumption sector categories

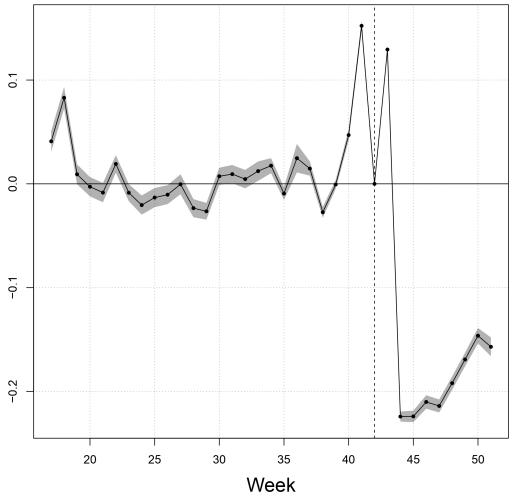
Sector	Merchant categories
Beauty and Clothes	Hair salon, cosmetics, boutiques, clothes, watch shops, and eyeglasses
Car and Refuel	Car sales, car services/goods, and gas
Education	Study room, private cram school, and educational supplies
Food and Beverages	Agricultural and fishery products, butchers, and others
Furniture	Electronics, furniture, and others
Housing	Household services, laundry, work-related services, and interior design
Leisure	Sport activities, movie/play, bookstore, and flower shops
Medical Care	Hospitals, drugstores, and other medical related services
Restaurant and Bar	Restaurants, bakeries, cafes, and karaoke
Retail	Car sales, car services/goods, and gas
Travel	Hotels, accommodation services and duty-free shops



(a) Card Spending

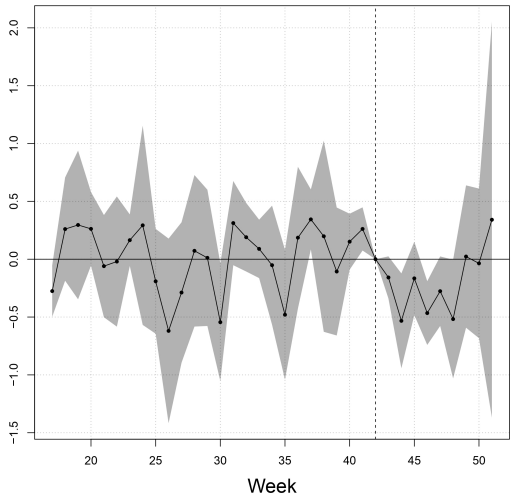


(b) Transaction Counts

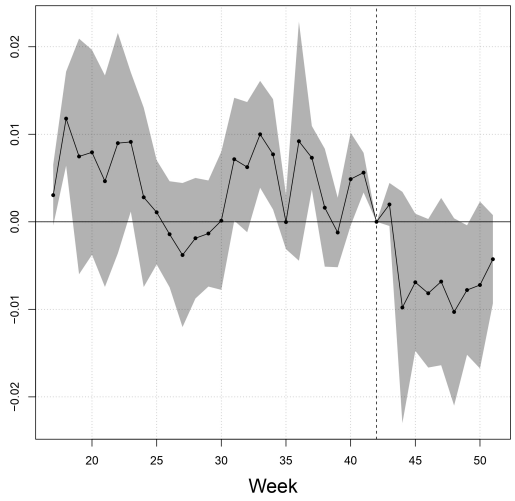


(c) Foot Traffic

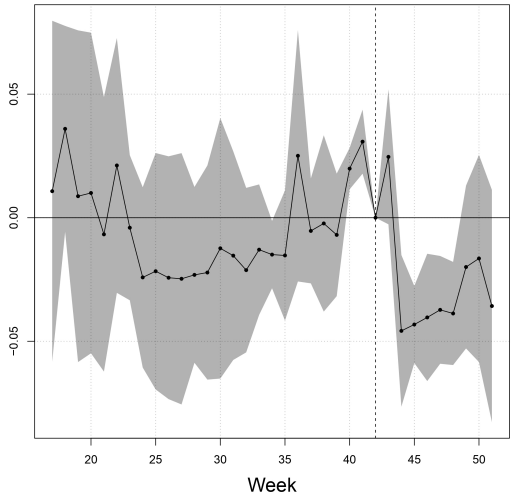
Figure 2: Dynamic effects of the Itaewon crowd crush in Itaewon 1-dong



(a) Card Spending

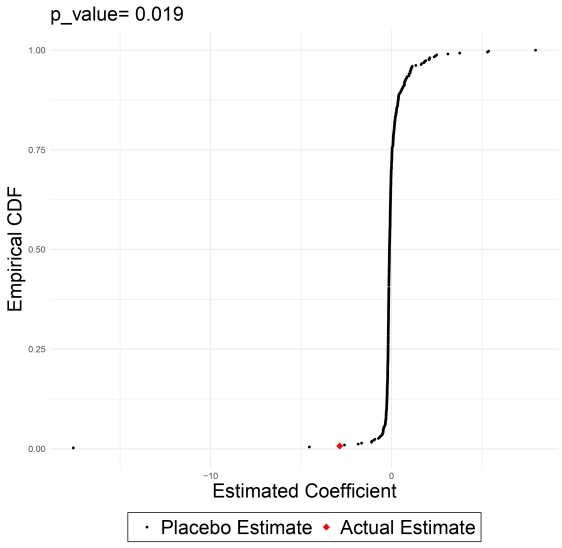


(b) Transaction Counts

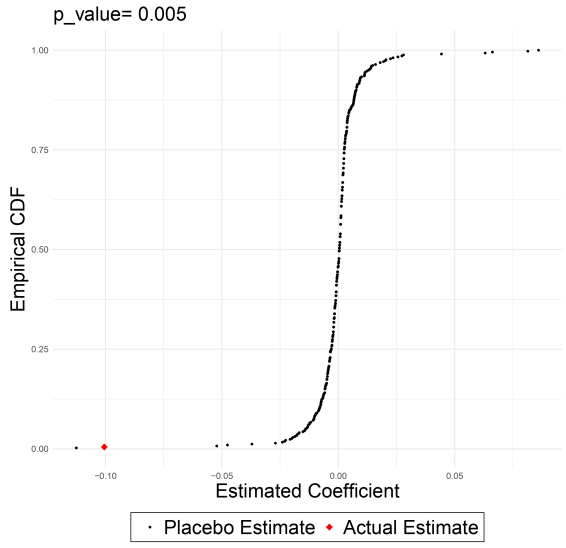


(c) Foot Traffic

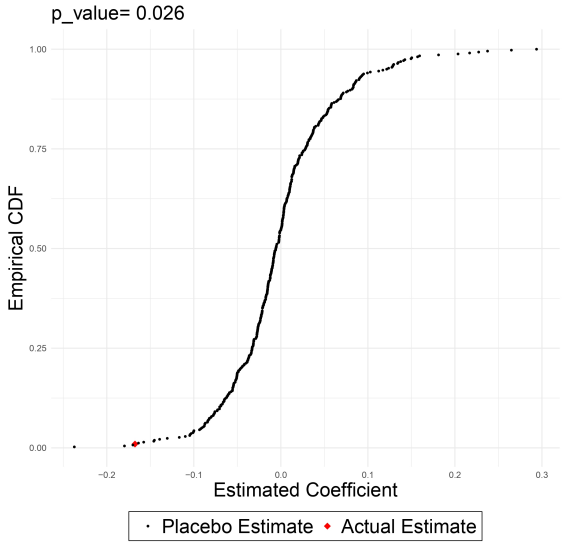
Figure 3: Dynamic effects of the Itaewon crowd crush in adjacent areas of Itaewon 1-dong



(a) Card Spending

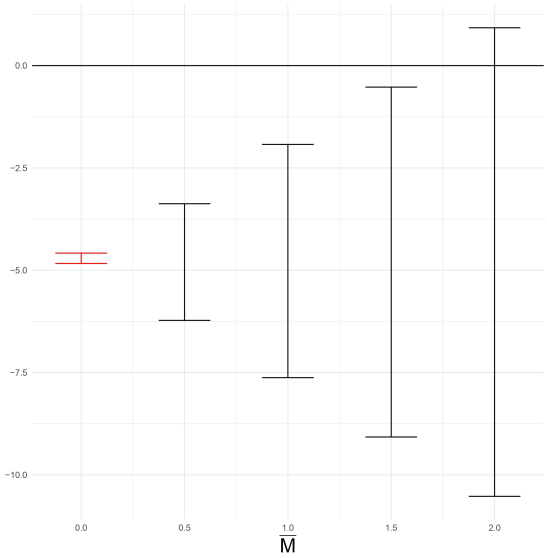


(b) Transaction Counts

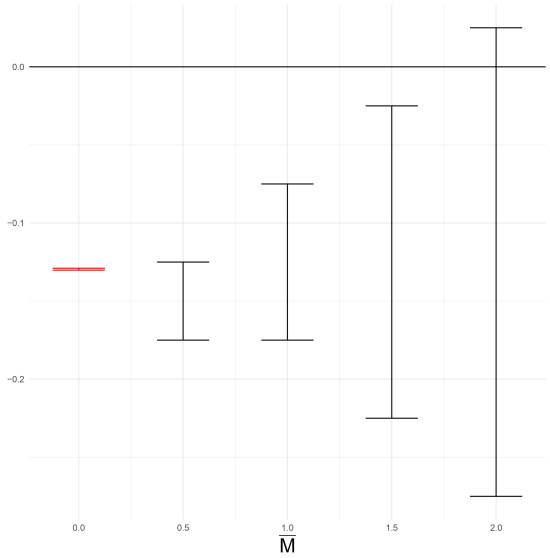


(c) Foot Traffic

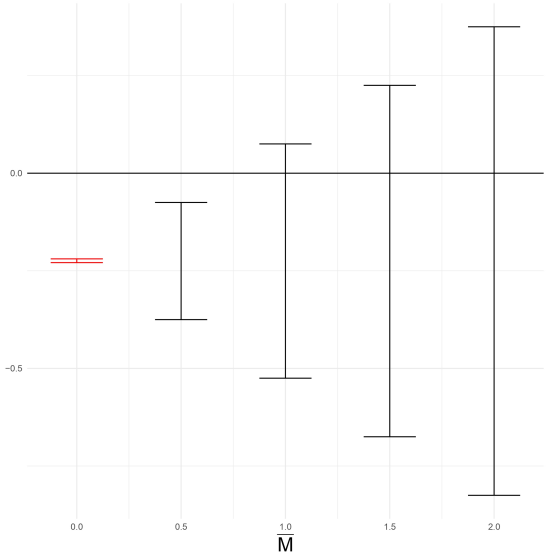
Figure 4: Permutation test for difference-in-differences estimates of Itaewon 1-dong



(a) Card Spending

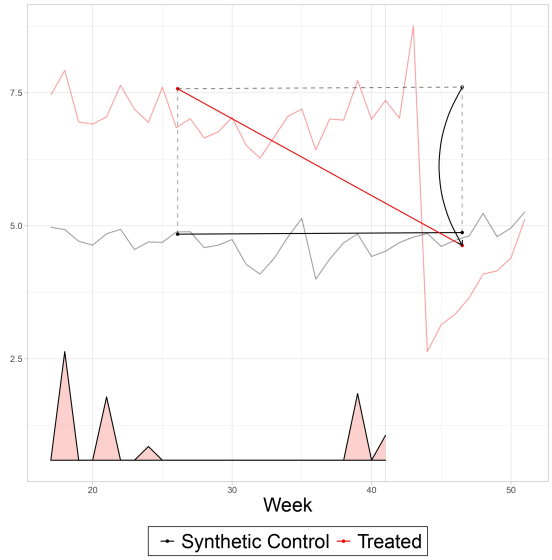


(b) Transaction Counts

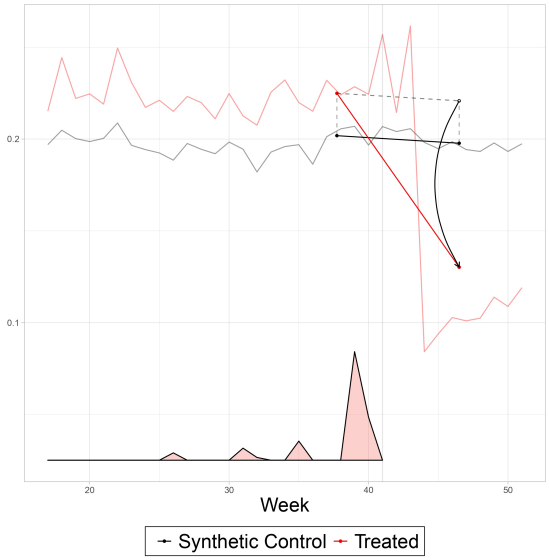


(c) Foot Traffic

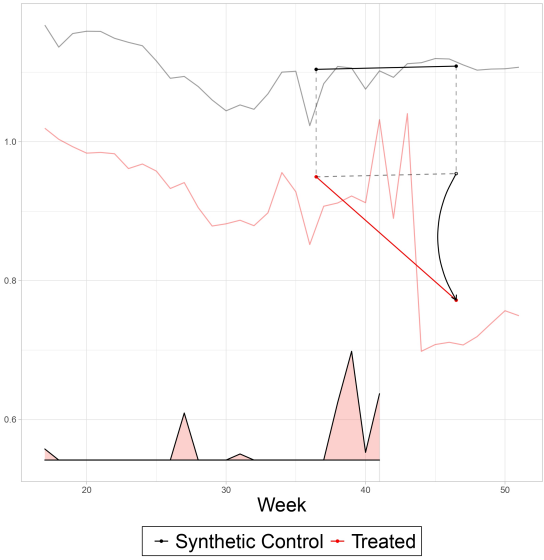
Figure 5: Sensitivity test for the event study method estimates of Itaewon 1-dong



(a) Card Spending



(b) Transaction Counts



(c) Foot Traffic

Figure 6: Plotting results of synthetic difference-in-difference estimation method in Itaewon1-dong

Notes: The pink shaded part indicates the time weight of each week before the Itaewon crowd crush.