The impact of social distancing on box-office revenue: Evidence from the COVID-19 pandemic

In Kyung Kim
Nazarbayev University

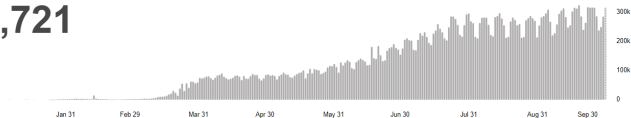October 2020

Unprecedented health crisis in 2020
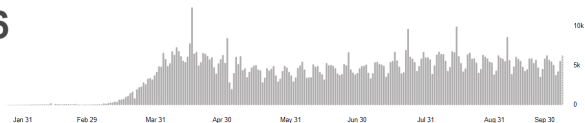

Global Situation
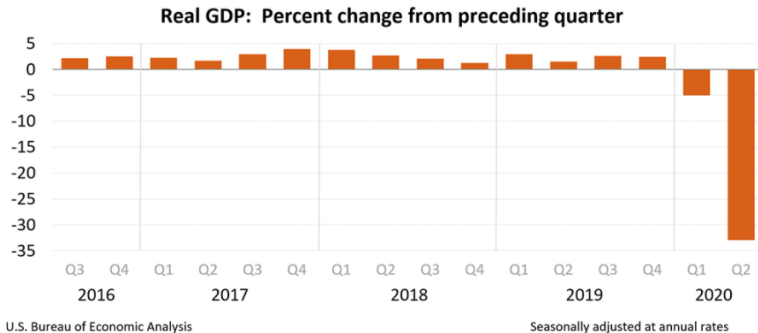
Daily | Weekly

34,161,721
confirmed cases

1,016,986
deaths

Source: World Health Organization
Data may be incomplete for the current day or week.

Economic Consequences of the COVID-19

Real GDP: Percent change from preceding quarter

U.S. Bureau of Economic Analysis

Seasonally adjusted at annual rates

The new normal of social distancing.

Research question

- Study the short-run impact of social distancing due to the COVID-19 outbreak on the Korean movie theater industry.

  - ▶ Focus on consumers' voluntary social distancing practices rather than government-imposed restrictions.

- Distinguish between the revenue loss caused by reduced movie demand and the loss attributed to the endogenous market reaction.

  - ▶ Distributors delayed some of their potentially popular movies.

  - ▶ Important for managerial decision.

Findings

- Strong negative impact of the COVID-19 outbreak on consumer utility.

    - The magnitude is largest in densely populated metropolitan areas.

    - People are more afraid of going to the cinema when they are more concerned about the pandemic.

- Strong negative impact of the COVID-19 outbreak on the box-office revenue.

    - 34 percent decrease in sales in the short-run: 52 million dollars during the first five weeks after the outbreak.

    - An additional 42 million dollars were lost due to the delay of some major movies.

Previous works

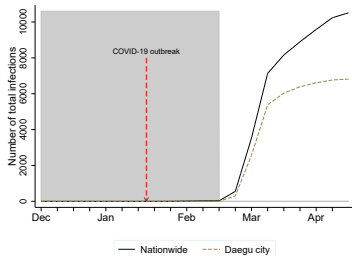- Epidemiology and economics

  - ▶ Analyzing the efficiency of fiscal and monetary policies (Guerrieri et al., 2020, Faria-e Castro et al., 2020).

  - ▶ Deriving the optimal mitigation policies (Eichenbaum et al., 2020, Alvarez et al., 2020, Jones and Venkateswaran, 2020).
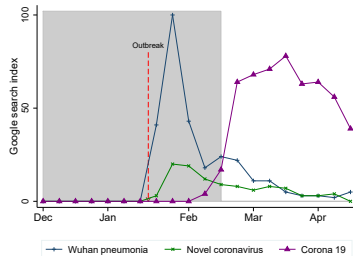
- Movie demand

  - ▶ Nested logit framework for movie demand estimation (Einav, 2007, Moul, 2007, Leung et al., 2019)

Outbreak of COVID-19 in Korea

(i) Number of confirmed cases **(ii) Google search trend**
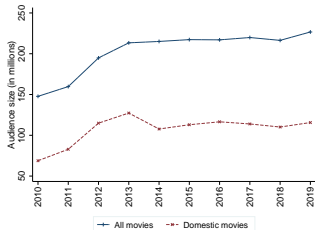
Shaded area covers weeks included in the sample period.

Source: Korea Centers for Disease Control and Prevention (KCDC) and Google Trends.

▶▶ data

Movie theater industry

(i) Yearly audience size

(ii) Weekly audience size
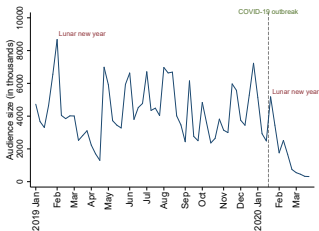
(iii) Monthly ticket price
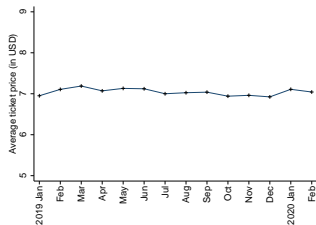
Source: Korean Film Council Annual Reports and KOBIS.

Distribution and exhibition in 2019

Type	Distribution		Exhibition	
	Movies	Audience (in millions)	Theaters	Screens
Integrated firms				
CJ	19	53	168	1,221
Lotte	15	16	130	915
JContentree	6	2	102	699
Non-integrated theaters			113	244
Non-integrated distributors				
Foreign distributors	1,247	111		
Other domestic distributors	657	45		
Total	1,944	227	513	3,079

Source: Korean Film Council Annual Report 2019.

Number of new movies

Year	Month	Distributors	
		All	Major
2019	1	27	13
2019	2	32	12
2019	3	24	10
2019	4	25	10
2019	5	30	10
2019	6	21	9
2019	7	25	11
2019	8	27	9
2019	9	31	10
2019	10	38	10
2019	11	32	8
2019	12	27	11
2020	1	24	7
2020	2	16	9

Source: KOBIS. ▸▸ difference

Data

- Restrict the sample period up to the third week of February.

  - ▶ The effect of social distancing is unlikely to be the same. `▶ trend`

  - ▶ Chains started to close some theaters starting in late March.

  - ▶ Schools and universities in Korea normally start in March.

- Download demand information between January 2017 and February 2020 from the Korea Box-office Information System (KOBIS).

  - ▶ 78,635 movie-market-week level observations with 1,136 movie titles

  - ▶ Include 7 metropolitan cities and 9 provinces

  - ▶ Define each of them as a market, and market size as the number of Koreans between age 10 and 80 years.

Movie demand

Consumer i's utility from watching movie j in market m at time (year-week) t, u_{ijmt}:

$$u_{ijmt} = \delta_{jmt} + v_{imt} + (1 - \sigma)\varepsilon_{ijmt}$$
$$= \alpha_j + \beta r_{jt} + \mathbf{x}_{mt}\gamma + \xi_{jmt} + v_{imt} + (1 - \sigma)\varepsilon_{ijmt},$$
$$u_{i0mt} = v'_{imt} + (1 - \sigma)\varepsilon_{i0mt}.$$

- δ_{jmt} is the mean utility.

- $v_{imt} + (1 - \sigma)\varepsilon_{ijmt}$ is the idiosyncratic taste shock, where $\sigma \in [0, 1]$.

Movie demand

- The idiosyncratic taste shock is extreme value distributed (Cardell, 1997, Berry, 1994).

- The nested logit probability of going to the cinema (the industry market share) is

$$s_{mt} = \frac{D_{mt}^{1-\sigma}}{1 + D_{mt}^{1-\sigma}}, \tag{1}$$

where $D_{mt} \equiv \sum_{f=1}^{\mathcal{F}_{mt}} \exp\left(\delta_{fmt}/(1-\sigma)\right)$ and $\mathcal{F}_{mt}$ is the set of available movies. ▸ loss

- The predicted market share of movie j and the market share of the outside option is

$$s_{jmt} = \frac{\exp(\delta_{jmt}/(1-\sigma))}{D_{mt}^{\sigma}(1 + D_{mt}^{1-\sigma})} \text{ and } s_{0mt} = \frac{1}{1 + D_{mt}^{1-\sigma}}. \tag{2}$$

Movie demand

From (1) and (2), obtain a linear regression model:

$$\ln\left(\frac{s_{jmt}}{s_{0mt}}\right) = \alpha_j + \beta r_{jt} + \mathbf{x}_{mt}\gamma + \sigma \ln\left(\frac{s_{jmt}}{\sum_{f=1}^{\mathcal{F}_{mt}} s_{fmt}}\right) + \xi_{jmt}. \qquad (3)$$

- The vector $\mathbf{x}_{mt}$ includes the two binary variables, $COVID - 19$ and $Holiday$, as well as market and week fixed effects.

- Also, interact $COVID - 19$ with market dummies.

Identification

- The identification of the COVID-19 effect hinges on the presence of movies released before the COVID-19 outbreak and played during the pandemic.

- An illustration:
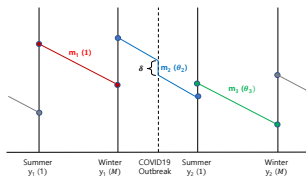
	Season	
Movie	Summer	Winter
m_1	1	λM
m_2	$\lambda\theta_2(1-\delta)$	$\theta_2 M$
m_3	$\theta_3(1-\delta)$	$\lambda\theta_3(M-\delta)$

Identification

- The within-industry market share is endogenous.

- Use the average the within-industry market share in other markets at the same time as the instrumental variable (Hausman, 1996, Nevo, 2001).

- The key identifying assumption is that ξ_{jmt} is uncorrelated across markets. ⏩ robust

Estimation results

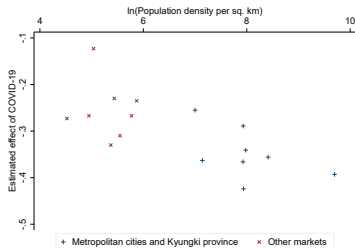| Variable	First Coeff.	First Std. Err.	Second Coeff.	Second Std. Err.
Number of weeks passed	-0.006	(0.001)***	-0.001	(0.000)***
COVID-19	-0.080	(0.100)	-0.330	(0.018)***
× *Busan*	0.102	(0.136)	-0.026	(0.017)
× *Choongnam*	-0.001	(0.151)	0.020	(0.016)
× *Daegu*	0.048	(0.107)	-0.094	(0.024)***
× *Daejeon*	0.094	(0.105)	0.041	(0.016)**
× *Gwangju*	0.018	(0.125)	-0.011	(0.017)
× *Incheon*	-0.017	(0.107)	-0.036	(0.016)**
× *Jeju*	-0.146	(0.119)	0.095	(0.016)***
× *Jeonam*	-0.224	(0.142)	0.207	(0.017)***
× *Jeonbook*	-0.108	(0.138)	0.100	(0.016)***
× *Kangwon*	-0.117	(0.114)	0.057	(0.017)***
× *Kyungbook*	-0.097	(0.137)	0.063	(0.021)***
× *Kyungki*	-0.281	(0.154)*	-0.033	(0.017)*
× *Kyungnam*	-0.216	(0.127)*	0.063	(0.017)***
× *Seoul*	0.280	(0.152)*	-0.063	(0.018)***
× *Ulsan*	0.064	(0.114)	0.075	(0.016)***
Holiday	-0.025	(0.020)	0.823	(0.004)***
ln(Within industry M/S)			0.992	(0.001)***
Instrumental variable	0.950	(0.003)***		

Market characteristics and the size of the COVID-19 effect

(i) Population density

(ii) Per capita screening capacity
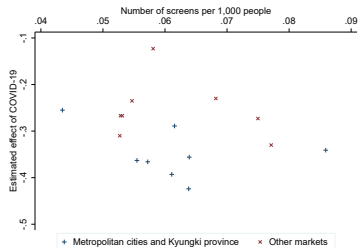
Distribution of the movie fixed effects

Average quality

2020   : -0.5
2017-2019: -0.2

Density

Movie fixed effects

Movies released during the pandemic period in 2020
Movies released during the same period in the previous years

▸▸ difference
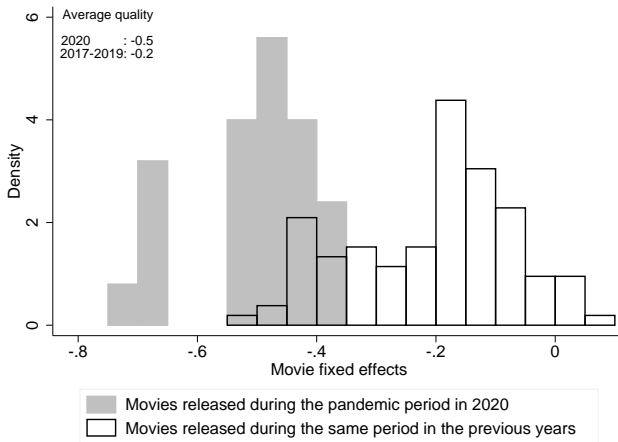
Revenue loss

- Examine what box-office revenue would have been during the first five weeks after the outbreak of COVID-19 had it not broken out.

- The counterfactual industry market share in market m at time t is:

$$s_{mt}^* = \frac{\left(\sum_{f=1}^{\mathcal{F}_{mt}} \exp(\hat{\delta}_{fmt}^*/(1-\hat{\sigma}))\right)^{1-\hat{\sigma}}}{1 + \left(\sum_{f=1}^{\mathcal{F}_{mt}} \exp(\hat{\delta}_{fmt}^*/(1-\hat{\sigma}))\right)^{1-\hat{\sigma}}},$$

where $\hat{\delta}_{fmt}^*$ is the predicted mean utility of the movie with the value of $COVID-19$ equal to zero instead of one. ▸ model

Revenue loss

- The short-run revenue loss owing to the social distancing practices in market m, RL_m, is

$$RL_m = \sum_{t=1}^{5} p_{mt} \left(s_{mt}^* - s_{mt} \right) \cdot MS_m,$$

where p_{mt} is the average admission price and MS_m is the market size.

Revenue loss

Market	Estimated revenue loss	95% Confidence interval		Theater count	Revenue loss per theater
		Lower bound	Upper bound		
Busan	4,111	3,619	4,602	29	142
Choongbook	1,339	1,083	1,596	19	70
Choongnam	1,582	1,246	1,918	25	63
Daegu	2,818	2,532	3,104	25	113
Daejeon	1,546	1,301	1,791	14	110
Gwangju	1,721	1,462	1,979	17	101
Incheon	2,671	2,238	3,104	27	99
Jeju	397	326	468	6	66
Jeonam	403	286	520	21	19
Jeonbook	1,076	873	1,279	27	40
Kangwon	1,068	865	1,272	26	41
Kyungbook	1,249	1,020	1,477	30	42
Kyungki	12,789	11,497	14,081	115	111
Kyungnam	2,100	1,773	2,428	32	66
Seoul	16,491	14,616	18,365	90	183
Ulsan	872	709	1,035	8	109
Total	52,253			511	102

Box-office revenue comparison

Market	Revenue (4th-8th weeks)		Difference
	2019	2020	
Busan	13,836	7,358	6,479
Choongbook	5,358	2,782	2,577
Choongnam	6,271	3,287	2,985
Daegu	10,419	5,249	5,171
Daejeon	6,797	3,712	3,085
Gwangju	6,939	3,703	3,236
Incheon	10,498	5,165	5,333
Jeju	2,073	1,189	885
Jeonam	4,469	2,467	2,002
Jeonbook	5,925	3,222	2,703
Kangwon	4,878	2,492	2,385
Kyungbook	6,544	3,325	3,218
Kyungki	48,929	24,238	24,691
Kyungnam	10,240	5,507	4,733
Seoul	48,803	26,535	22,268
Ulsan	4,327	2,301	2,026
Total	196,307	102,532	93,775

Revenue loss

During the five weeks after the outbreak of COVID-19

- The estimated revenue loss is 52 million dollars.

- The observed box-office revenue is 102 million dollars.

- Social distancing caused a sales drop of 34 percent in the industry.

Revenue loss

During the five weeks after the outbreak of COVID-19

- The estimated revenue loss is 52 million dollars.

- The sales difference between 2019 and 2020 is 94 million dollars.

- This discrepancy can be largely attributed to endogenous movie quality choice by distributors. ▶▶ nmovies   ▶▶ quality

Robustness

- Alternative identification strategy. ▸▸ iv

  - ▶ Use the average within-industry market share among provinces (metropolitan cities) as the instrumental variable if the focal market is a metropolitan city (province).

  - ▶ Use the number of major movies as the instrumental variable for the within-industry market share (Einav, 2007).

- Time-varying effect of the COVID-19 pandemic.

  - ▶ Use $Search_{mt}$, the *Google* search volume related to the virus in market m in week t, as the proxy for the degree of concern:

$$(\psi_m + \tau Search_{mt}) \, COVID-19_t.$$

  .

Robustness: Demand estimation

| | Alternative identification strategy | | | | Time-varying pandemic effect | | | |
| | (1) | | (2) | | (3) | | (4) | |
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
r	-0.002	(0.000)***	-0.040	(0.006)***	-0.001	(0.000)***	-0.001	(0.000)***
r × COVID19							-0.006	(0.002)***
COVID19	-0.308	(0.019)***	-1.062	(0.134)***	-0.328	(0.018)***	-0.291	(0.026)***
× Busan	-0.020	(0.017)	0.249	(0.090)***	-0.027	(0.017)	-0.017	(0.014)
× Choongnam	0.020	(0.016)	0.077	(0.072)	0.019	(0.016)	0.019	(0.013)
× Daegu	-0.081	(0.024)***	0.008	(0.066)	-0.096	(0.024)***	-0.095	(0.021)***
× Daejeon	0.039	(0.016)**	0.067	(0.067)	0.040	(0.016)**	0.041	(0.012)***
× Gwangju	-0.009	(0.017)	0.031	(0.064)	-0.012	(0.017)	-0.012	(0.014)
× Incheon	-0.036	(0.016)**	0.102	(0.071)	-0.036	(0.016)**	-0.036	(0.013)***
× Jeju	0.096	(0.016)***	-0.011	(0.059)	0.095	(0.015)***	0.091	(0.013)***
× Jeonam	0.208	(0.017)***	0.079	(0.075)	0.207	(0.017)***	0.202	(0.014)***
× Jeonbook	0.101	(0.016)***	0.182	(0.072)**	0.099	(0.017)***	0.096	(0.013)***
× Kangwon	0.057	(0.017)***	0.043	(0.062)	0.057	(0.017)***	0.057	(0.013)***
× Kyungbook	0.067	(0.021)***	0.152	(0.071)**	0.063	(0.021)***	0.060	(0.018)***
× Kyungki	-0.029	(0.016)*	0.103	(0.072)	-0.034	(0.017)**	-0.027	(0.014)*
× Kyungnam	0.062	(0.017)***	0.120	(0.068)*	0.064	(0.017)***	0.063	(0.014)***
× Seoul	-0.054	(0.018)***	0.345	(0.100)***	-0.064	(0.018)***	-0.050	(0.016)***
× Ulsan	0.076	(0.016)***	0.083	(0.070)	0.074	(0.017)***	0.074	(0.013)***
COVID19 × Search					-0.002	(0.000)***	-0.001	(0.000)***
Holiday	0.823	(0.004)***	0.662	(0.029)***	0.821	(0.004)***	0.811	(0.005)***
Holiday × COVID19							0.082	(0.015)***
ln(Within M/S)	0.991	(0.001)***	0.644	(0.051)***	0.992	(0.001)***	0.992	(0.001)***

Robustness: Revenue loss

Market	Alternative identification		Time-varying effect	
	(1)	(2)	(3)	(4)
Busan	4,575	6,165	4,113	3,822
Choongbook	1,251	2,617	1,338	1,085
Choongnam	1,453	2,913	1,578	1,331
Daegu	2,816	4,484	2,817	2,637
Daejeon	1,426	3,251	1,544	1,295
Gwangju	1,751	3,163	1,721	1,507
Incheon	2,560	4,658	2,666	2,383
Jeju	363	1,281	397	335
Jeonam	331	1,745	403	320
Jeonbook	982	2,247	1,075	862
Kangwon	986	2,299	1,067	843
Kyungbook	1,140	1,820	1,247	1,120
Kyungki	12,709	12,975	12,782	11,564
Kyungnam	2,090	2,790	2,097	1,863
Seoul	18,798	20,355	16,488	15,577
Ulsan	792	2,222	871	737
Total	54,024	74,985	52,204	47,282

Conclusions

- Studied the short-run impact (the first five weeks after the outbreak) of the COVID-19 outbreak on the Korean movie theater industry

  - ▶ The COVID-19 outbreak had a strong negative impact on consumer utility in all markets in Korea.

  - ▶ Reduced demand incurred 34 percent decreases in sales.

  - ▶ Additional 42 million dollars were lost due to the drop in movie quality.

- Future works

  - ▶ How manu consumers would come back?

  - ▶ The implication of the change in market structure.