Mass Gathering Sport Events and The Spread of Viral Respiratory Infection: Japanese Professional Baseball and Influenza

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Motivation

COVID-19 $\longrightarrow$ sport leagues shut down.

Were these effective?

- Ahammer et al. (2020) – additional NHL/NBA games increased COVID-19 deaths
- Olczak et al. (2020) – additional soccer matches in an area in March increased April Covid deaths

What about the seasonal flu?

- Stoecker et al. (2016) – a franchise that makes the Super Bowl increases influenza deaths amongst those 65 and older
- Cardazzi et al. (2020) – the presence of teams increases local influenza mortality

What about the **intensive margin**? What about **cases**?

Preview of Results

Setting: Nippon Professional Baseball (NPB), 1999 to 2018

Methodology: Fixed Effects

- Year
- Prefecture-by-Week
- # of Games scheduled is exogenous to flu outcomes

Results: NPB Games $\longrightarrow$ Flu

- 1 Game $\longrightarrow$ 0.18 cases per SMI (2.5% of mean)
- 0.18 cases per SMI $\longrightarrow \approx$ 400 additional flu cases
- The NPB season is responsible for $\approx$ 2.3% of all influenza cases during analysis period.

Data

Influenza Data: 47 prefectures, $\approx$ 5,000 SMIs

- # of Diagnoses
- Excludes avian & pandemic flu

NPB Data: March 1999 – November 2018 (19,142 games)

- Timing (Pre-, Regular, Post-season)
- Attendance
- Venue information (capacity, dome, location)

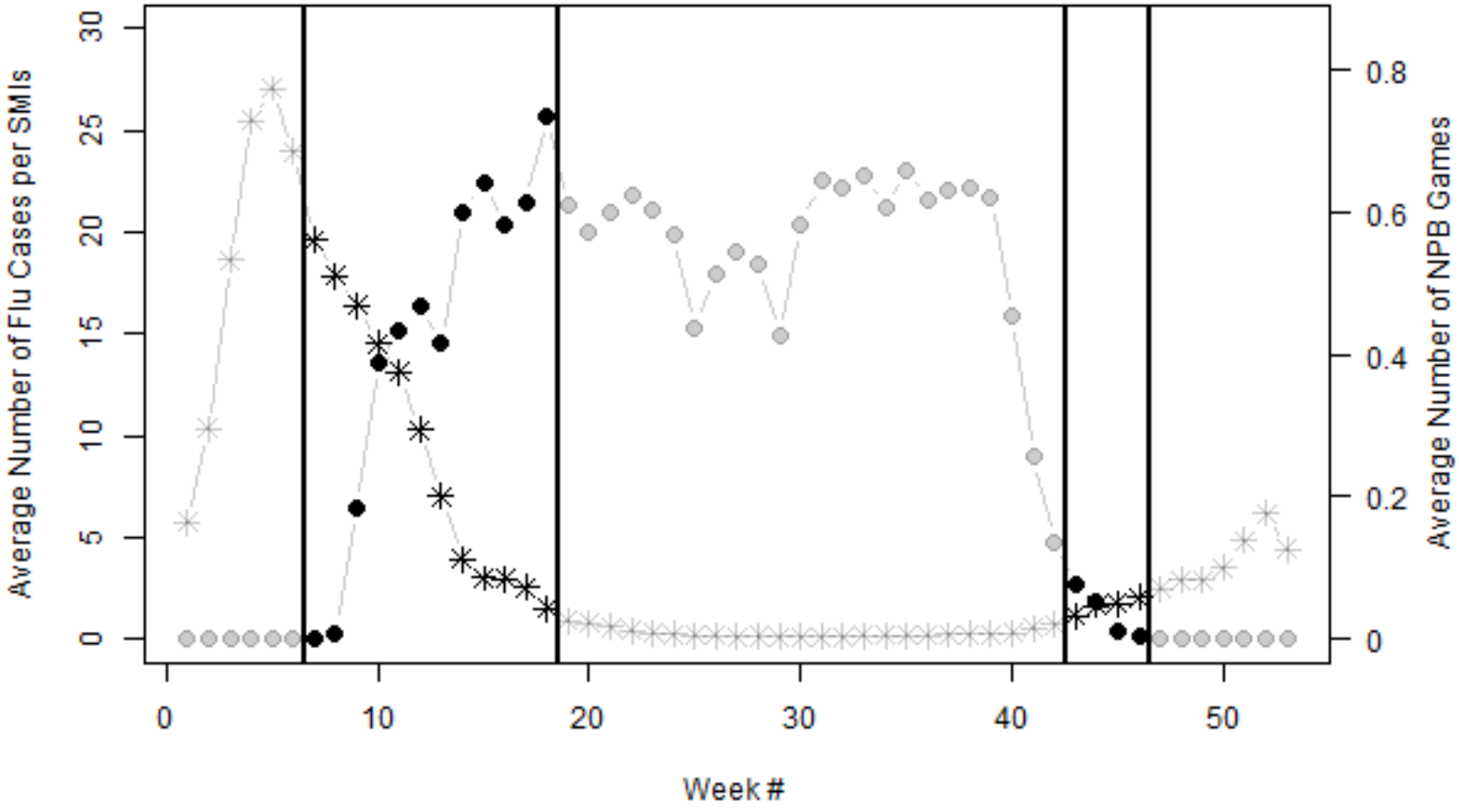
Control Variables:

- Weather (temperature, humidity)
- Population information

Unit of Analysis: Prefecture by Week

Averages by Week

To Robustness



Summary Statistics

Statistic	Mean	St. Dev.	Min	Max
Influenza per SMI	7.3	10.7	0	82.7
Games_t	0.327	1.102	0	12
Games_{t-1}	0.290	1.027	0	12
Population Den.	1,368.1	1,692.2	236.3	9,724
Temp.	11.478	5.01	-6.8	26.9
Humidity	65.194	8.587	28	91

N = 14,706

Empirical Specification

$$F_{it} = \alpha_0 + \beta S_{it} + \gamma W_{it} + \delta P_{iy} + \zeta_y + \eta_i \times \lambda_w + \varepsilon_{it}$$

where

F_{it}: Influenza Cases per SMI in Prefecture i & Week t

S_{it}: # of Mass Gathering Events (NPB Games)

W_{it}: weather controls (temperature & precipitation)

P_{it}: population density

ζ_y: flu season fixed effect

$\eta_i \times \lambda_w$: a prefecture-by-week fixed effect

Results – NPB Games

	Dependent variable:
	Flu Cases per SMI
Home Games$_t$	0.184***
	(0.068)
Home Games$_{t-1}$	0.179***
	(0.053)
Observations	14,706
Adjusted R^2	0.563
Note:	*p<0.1; **p<0.05; ***p<0.01

Results – Indoor / Outdoor

	Dependent variable:
	Flu Cases per SMI
Home Games$_t$ (Outdoor)	0.017
	(0.076)
Home Games$_{t-1}$ (Outdoor)	0.052
	(0.056)
Home Games$_t$ (Indoor)	0.341***
	(0.089)
Home Games$_{t-1}$ (Indoor)	0.288***
	(0.074)
Observations	14,706
Adjusted R^2	0.563
Note:	*p<0.1; **p<0.05; ***p<0.01

Results – 50% Capacity

	Dependent variable:
	Flu Cases per SMI
Home Games$_t$ ($< 50\%$)	0.166^{**}
	(0.078)
Home Games$_{t-1}$ ($< 50\%$)	0.057
	(0.087)
Home Games$_t$ ($> 50\%$)	0.230^{*}
	(0.125)
Home Games$_{t-1}$ ($> 50\%$)	0.259^{**}
	(0.122)
Observations	10,523
Adjusted R^2	0.548
Note:	*p<0.1; **p<0.05; ***p<0.01

Results – Attendance

	Dependent variable:
	Flu Cases per SMI
Home Games Attendance$_t$	0.008*
	(0.004)
Home Games Attendance$_{t-1}$	0.008**
	(0.004)
Observations	10,523
Adjusted R^2	0.548
Note:	*p<0.1; **p<0.05; ***p<0.01

Robustness

To Averages by Week

Expanding Sample Window: Significance and estimate size decreases as the window widens.

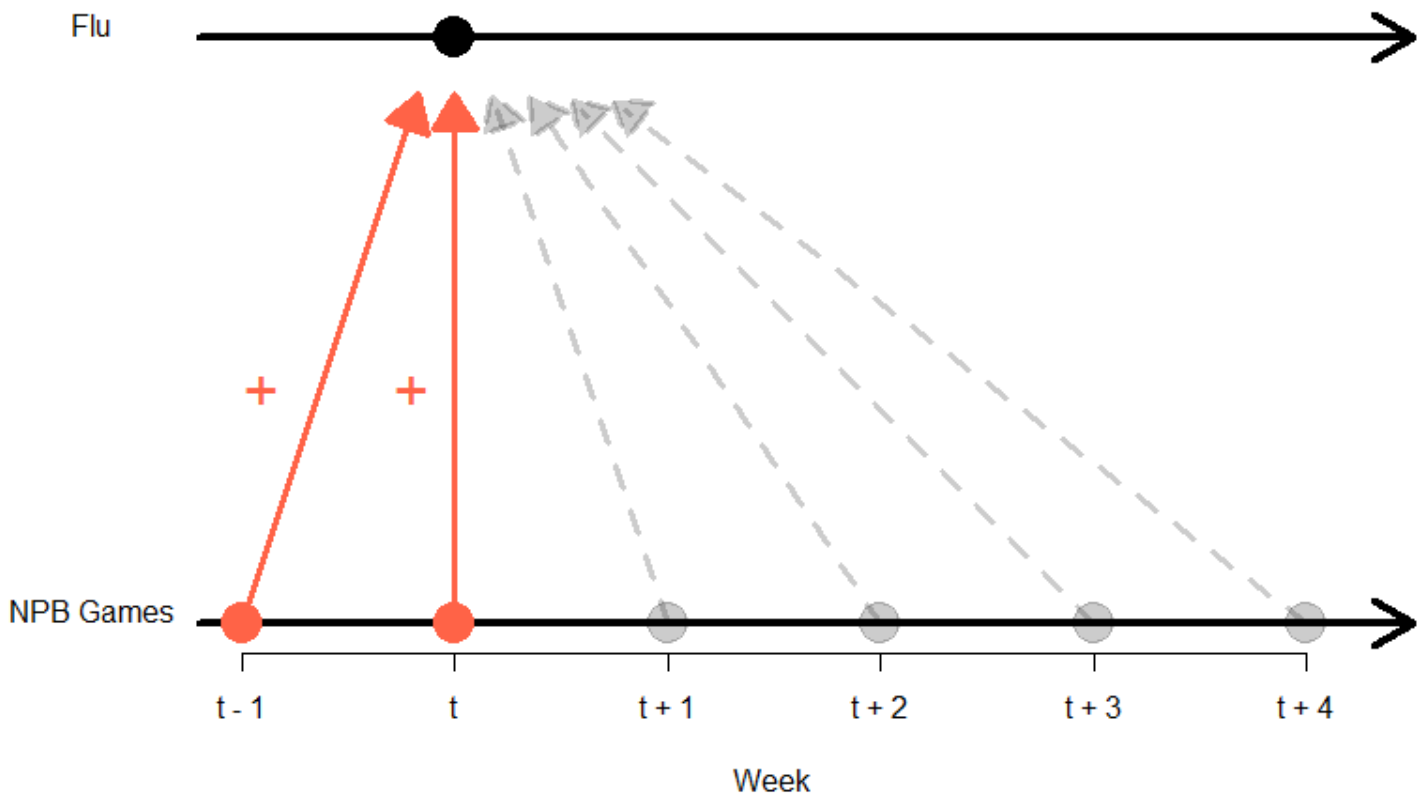
Sliding Sample Window: Significance and estimate size increases as the windows approach January 1.

Drop-One Prefecture: t-Statistic for difference between largest and smallest coefficients $\approx .9$.

Excluding Prefectures w/o Teams: Coefficient magnitudes are (insignificantly) stronger.

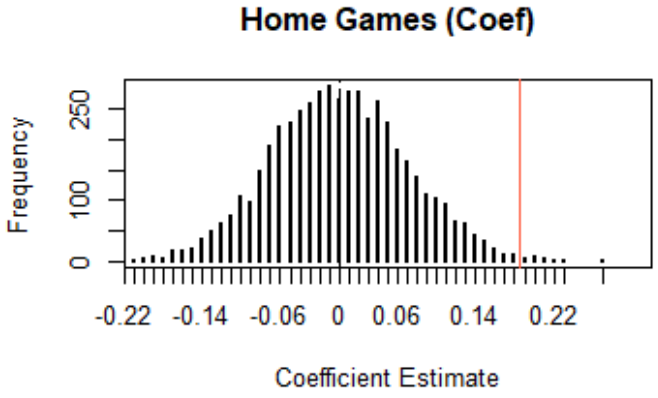
Falsification

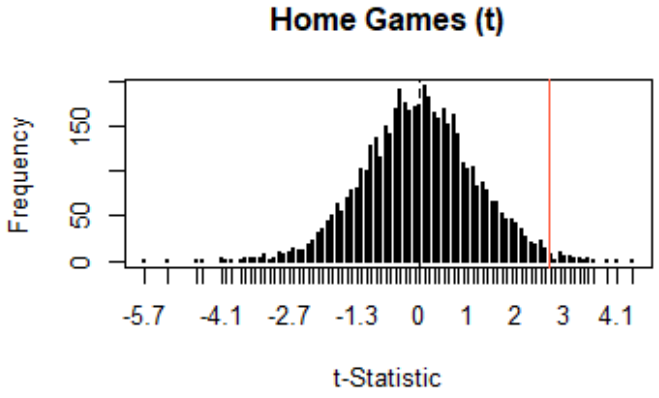
Effect of NPB_{t+i} on Flu_t: We find an insignificant effect of *future* NPB games on *current* flu cases.

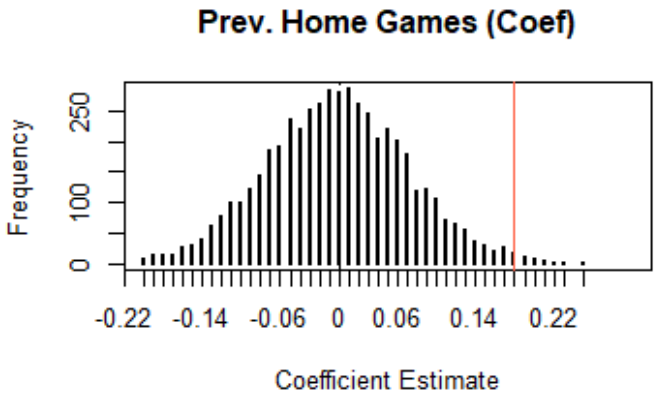


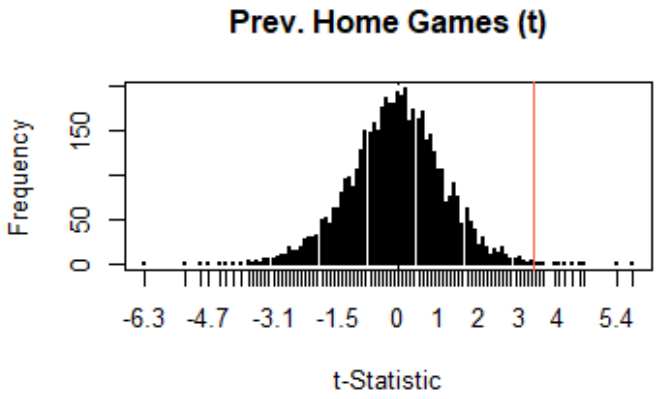
Falsification

Shuffling NPB games within season-prefecture combinations 5000x: We find "exact" p-values of 0.0084 and 0.0030 (estimated p-values: 0.0097 and 0.0015).









Conclusion

In line with the literature, we find that additional mass gatherings increase influenza transmission.

The results of this study support the decision by the Japanese government, and many others, to limit attendance at stadiums.

Dome stadiums present a larger risk in terms of influenza transmission