Do Local Businesses Benefit from Stadiums? The Case of Major Professional Sports League Arenas

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Abstract

Stadium construction, which can cost hundreds of millions of dollars, is often subsidized by public sources. In many cases, subsidies are allocated on the premise that sports venues benefit the local economy by bringing new customers to nearby businesses. To pin down the size and the spatial distribution of such spillovers, we use daily foot traffic data covering major sports league arenas and the surrounding commercial establishments. By employing the fixed effects and the IV estimation strategies, we show that the spillover benefits are heterogeneous across sports and business sectors. We find that 100 baseball stadium visits generate roughly 29 visits to nearby food & accommodation businesses and about 6 visits to local retail establishments. While the estimates for football stadiums are comparable, basketball & hockey arenas do not appear to generate significant spillovers for the surrounding businesses. Using our spillover estimates, we also compute an upper bound on the additional local spending induced by each sample arena. The median value of the additional spending turns out to be substantially smaller than the corresponding stadium subsidy.

Keywords: Stadiums; Spatial Spillovers; Establishment-level data.

JEL codes: H23, H71, R58, Z20.

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1 Introduction

Stadiums hosting professional sports teams have received more than $12 billion in subsidies between 2000 and 2010[1]. Subsidies are often rationalized by the idea that stadiums catalyze local economic development (see, e.g., The Atlantic or NBC Sports), and yet, according to the 2017 survey by IGM and Whaples (2006) the economics profession generally agrees that the grounds for stadium subsidies are weak. As reviewed by Coates and Humphreys (2008), this consensus has to a large extent been driven by empirical evidence based on data aggregated at a relatively crude geographic level. At the same time, recent reports by the Associated Press and CNN Business suggest that businesses near stadiums usually dependent on the sports fans' spending have been suffering disproportionately more from the COVID-19 pandemic. This anecdotal evidence highlights a possibility that stadium spillover effects may be localized and thus difficult to detect using aggregate data. How large may these local spillover effects be? How do they differ across business industries? Do stadiums attract new consumers to local businesses or simply reallocate them from more distant businesses? In this paper, we provide new empirical evidence on these issues using daily data on foot traffic to 92 stadiums and local businesses as well as sports events occurrences in the four major professional sports leagues in the US: MLB, NBA, NFL and NHL. The assembled dataset allows us to estimate fixed effects and instrumental variable specifications that capture the number of visits to local businesses generated by the stadium visits. We find these spillover effects to be heterogeneous across stadium sports and business industries. Baseball and football stadiums generate traffic for local food & accommodation and retail trade businesses, while the corresponding effects for other sectors are substantially lower. As a preview, 100 additional baseball (football) stadium visits lead to roughly 29 (40) additional visits to food & accommodation businesses within 3 kilometers of the stadium. These effects are highly localized with most additional visits happening within 1 kilometer of the stadium. While basketball & hockey arenas appear to generate some spillovers in the 1-kilometer range as well, these additional visits are balanced by a corresponding small reduction in visits to further businesses, suggesting spatial redistribution of consumption. As a result, we estimated the overall local spillovers from basketball &

[1] Long (2013)

hockey stadiums to be statistically insignificant for all of the studied business sectors.

The spillover effects we estimated do not account for *all* aspects of spatial and temporal consumption redistribution: additional local business visits generated by the stadiums may come at the cost of lower spending on other days or in more distant localities. We thus interpret the estimated *local* spillovers as an upper bound on the *overall* spillovers. To put our estimates of the spillovers into perspective, we also report the projected upper bound for the total additional consumption spending generated for the businesses surrounding each stadium and compare them with the actual subsidies allocated to the facilities in our sample. Our findings indicate that for the median stadium receiving subsidies the public costs are substantially larger than the accumulated value of consumption spillovers.

These results are rendered possible by the rich dataset we assembled from several sources. First, we partnered with SafeGraph, a company specializing in location data. SafeGraph provided us with a database of US points-of-interest (including stadiums and businesses across a variety of industries) and their daily visit counts coming from mobile devices with participating apps installed. Second, we collected data from `sports-reference.com` to get information on the stadiums of the four major US sports leagues (MLB, NFL, NBA and NHL) including the stadium names and game dates. Finally, we gathered stadium capacity data from Wikipedia and used the amounts of stadium subsidies from Long (2013).

The assembled dataset allows us to exploit the day-to-day variation in stadium visits and the corresponding changes in visits to local businesses to estimate the causal stadium spillover effects. We use two estimation strategies – a fixed effects approach and an instrumental variable approach – to obtain the spillover effects. In both approaches, the total visit count to businesses located near stadiums plays the role of the independent variable, while the number of stadium visits is the independent variable. For the FE strategy, we introduce a stadium×month×day-of-week and date fixed effects to account for stadium-specific unobserved differences between sample months and days of the week as well as date-specific demand shocks common across stadiums (like public holidays). For the IV strategy, we use the game-day indicator as an instrument for stadium visits to reduce the concerns of (1) reverse-causality, (2) local non-sports events driving visits to both stadiums and businesses, (3) measurement error. While game days substantially affect foot traffic to stadiums, they are set well in advance and are unlikely to be correlated with the transitory demand conditions, thus alleviating the endogeneity concerns.

The obtained results indicate that baseball and football stadiums generate spillover visits to businesses in a subset of industries, while the null of no spillover effects cannot be rejected for the basketball & hockey arenas. Based on our preferred IV specifications, baseball stadiums induce spillovers for nearby food & accommodation and retail trade businesses, with spillovers mostly concentrated in the 1-kilometer range of the stadiums. Football stadiums appear to additionally affect foot traffic to local recreation facilities and other services businesses, with spillovers propagating to further neighborhoods up to 2.5 kilometers away from the stadiums. The localized nature of the effects potentially explains the difficulty of detecting spillovers earlier research has experienced using aggregate data.

Once the local spillover effects are estimated, we perform a simple back-of-the-envelope calculation using the data on stadiums subsidies (obtained from Long, 2013) to assess the magnitude of stadium-generated consumption benefits relative to public costs. In estimating these externality benefits, we use the data on the number of games, average event attendance statistics, and an assumption regarding the monetary value of a typical consumer for a local business. Since our estimates potentially do not account for all redistributional aspects of stadium-generated spillovers, we interpret our benefits calculation as an upper bound on the actual stadium-induced spillovers. Nevertheless, our results indicate that externality benefits created by the sports facilities in most cases are substantially smaller than the public costs associated with their building and financing. For a median stadium subsidy, we estimate externality benefits net of public costs to be negative at about -100 million dollars. Notably, for stadiums hosting football, hockey and basketball games we find that even the upper quartile net benefits are negative at about -$50M to -$70M, and only for baseball stadiums, which attract the largest attendance among the four sports, we find the upper quartile to be positive.

The rest of the paper is organized as follows. Section 2 summarizes the relevant literature. Section 3 describes our data sources. Section 4 outlines our empirical strategy and the estimation results. Section 5 provides a comparison between the spillover benefits and the stadiums' public costs.

Section 6 concludes.

2 Background and Literature

In the light of the continued public financial support for the construction and operation of professional sports facilities, a sizable body of work has been developed to investigate whether such expenditures are economically justified. Most of the early evidence in the literature appears to unambiguously suggest that stadiums hosting sports events have no tangible impact on the incomes and employment in their surrounding context (Coates, 2007) and that proponents of stadium and arena construction generally fail to account for the substitution of spending between different types of entertainment. Although these results have led many academics in the profession to settle on the unfavorable conclusion regarding stadium subsidies (Coates and Humphreys, 2008), several of the more recently published studies seek to find alternative ways to evaluate the benefits of sports arenas to the host cities.

The first argument, which was brought into attention by Nelson (2001) and later developed in Santo (2005), contends that the more recently built stadiums are different from the earlier ones because they are often purposefully integrated into the downtown area as opposed to being surrounded by suburban parking lots, and this difference of contexts may confound the impact found in earlier studies. While later discussions in the literature (Wassmer, 2001; Coates, 2007) have found that the central claims made by Nelson and Santo are not substantiated, these among other works have drawn attention to the differences present within and across locations where the stadiums choose to locate, as well as to the issue of pinning down the actual winners and losers from the stimulus provided to sports centers. Following the latter line, Coates and Humphreys (2003) examine employment statistics for 37 MSAs over the period from 1969 to 1997 and show that professional sports have a small positive effect on wages in one sector, namely, amusements and recreation, and an offsetting negative effect on both earnings and employment in eating and drinking and on employment in services and retail trade sectors.

Another commonly contested issue is that much of the early evidence comes from the data aggregated to the county or MSA level (with sports-related activities measured mostly at the annual frequency), which might not be sufficient to capture the temporal and localized effects of interest (Baade et al., 2008). In response to these concerns, Coates and Depken (2011) study the impact of sports events on the local economy using monthly sales taxes for 23 Texas towns and cities from January 1990 through December 2008 and again conclude that "an additional regular-season game has, at best, a modest effect on sales tax collections" (Coates, 2007).

Despite the noticeable shift towards research designs that allow for richer descriptions of the local business environments, only a few studies to date are based on establishment-level data. Notably, Harger et al. (2016) use 13 new stadiums that opened between 2002 and 2006 in 12 MSAs as natural experiments to estimate the effect of entry on nearby business activity in terms of the number of new businesses and workers. Based on their analysis of the data from Dun and Bradstreet MarketPlace, they conclude that there's no tangible effect on new business openings and that the effect on employment is weakly positive for the new businesses in the eating and drinking industry within 1 mile from the new facilities.

Finally, the most up-to-date piece of evidence on the topic is offered in Stitzel and Rogers (2019)[2], who use annual establishment-level sales data from the National Establishment Time-Series (NETS) to estimate the impact of the relocation of the National Basketball Association's Seattle franchise to Oklahoma City on local businesses. Stitzel and Rogers confirm the role of the consumption substitution channel by showing that while food establishments located between 1 and 2 miles from the arena show an increase in sales, there is a similar fall in entertainment sales in the same distance range, while the combined impact on sales for all related industries is insignificant.

The present study builds on the recent trend to employ detailed establishment-level data to uncover the spatially heterogeneous effects of professional sports facilities on the local economy. One major departure of this paper from the existing studies is the use of daily foot-traffic levels for stadiums and nearby businesses, obtained through a commercial provider of mobile device positioning data, as the

[2] Propheter (2020) is another related paper. The author uses a panel of establishments in Sacramento, CA, active from 2004 through 2018, and finds that retail establishments within a half-mile of the Golden 1 Center have survival times 53% shorter than otherwise similar retail establishments further away.

outcome of interest. Most importantly, the high geographic and temporal resolution of both treatment and outcome variables allows us to estimate the spatial externality gains caused by additional foot traffic attracted to major sports events while controlling for a rich set of location and time fixed effects.

3 Data

We use two data sources to estimate the spillover effects generated by the stadiums. First, we collected data from `sports-reference.com` to get information on the stadiums of four major US professional sports leagues (MLB, NFL, NBA and NHL) including the stadium names and game dates for the calendar year of 2018. Second, we partnered with SafeGraph, a company specializing in location data, which provided us with a database of points of interest – defined as places outside of home where people spend time and money – across the US and their corresponding visit counts on the daily level. The foot traffic information gathered by SafeGraph comes from the location data of mobile devices with installed participating applications. Developers of such applications share anonymized location information with SafeGraph which further aggregates the data to arrive at the visits counts on the point-of-interest level. From the full SafeGraph points-of-interest dataset we selected stadiums that match with the `sports-reference.com` data and nearby businesses located within 3 kilometers of each stadium. Additionally, we used stadium capacity data scraped off Wikipedia and stadium subsidy data from Long (2013) described in more detail in Section 5.

The rest of this section provides details on the assembled sample of stadiums and nearby businesses, depicts the variation in stadium visits and sports events over time that is essential for our empirical strategy, and explains the construction of the estimation sample.

3.1 Stadiums and their vicinities

According to the data collected from `sports-reference.com`, a website dedicated to professional sports data, there were 30, 29, 31 and 31 arenas used in MLB, NBA, NFL and NHL respectively between January and December 2018. We started from this set of stadiums and selected points of interest from the SafeGraph dataset that are located in the same state and share a similar name[3], using a Levenshtein distance threshold of 0.6. We also confirmed that, according to the SafeGraph data, the selected points of interest fall into the recreation category[4], manually checked the exact location of a subset of stadiums and verified that the areas of the matched points of interest are consistent with a typical stadium area. After the match, we obtain the stadium sample with 26, 25, 30 and 21 facilities in the baseball, basketball, football and hockey leagues respectively. It should be noted that 7 of the NHL arenas belong to Canadian teams and were thus not available to us in the SafeGraph dataset, explaining the relatively lower match rate for hockey arenas. Next, we used the SafeGraph database to select all points of interest located within 3 kilometers of each sample stadium. As a result, for the stadiums in our sample, we have the data on daily visit counts measured by SafeGraph, game dates for the calendar year of 2018, and a set of nearby businesses with their corresponding daily visits. The seating capacity information was scraped off Wikipedia and matched to the constructed sample by stadium name.

To provide a first glance into the context in which stadiums in our sample operate, Figure 1 displays every facility by sports on the map of the United States. Expectedly, Figure 1 reveals that sports facilities are primarily scattered across the major metropolitan areas: in fact, 29 of the highest populated 30 metropolitan areas have at least one stadium within their boundary.

Table 1a provides the summary statistics for the sample stadiums, broken down by the sport associated with the stadium. Arenas hosting basketball & hockey games saw roughly 44 games of these sports on average in 2018. An average baseball arena hosted about 80 games in 2018, while there were only around 9 NFL games (including the playoff stage) played in an average football stadium. However, football stadiums are larger and more capacious compared to the other sports arenas: with an average capacity of about 71 thousand seats, they scale more than three times larger than average basketball or hockey stadiums, and about 67% larger than an average baseball arena.

At the same time, football stadiums are located in less busy parts of the urban landscape. As shown in Table 1a, football stadiums have the lowest mean number of businesses nearby, 1.3 thousand in the

[3]For a subset of stadiums that were recently renamed, we also matched on the former arena name, as part of the SafeGraph data was collected prior to the stadium name change

[4]Two football stadiums, Ford Field and Mercedes Benz Superdome fell instead into the retail trade category, which appears to be an artifact of a machine learning approach used to categorizing some points of interest.

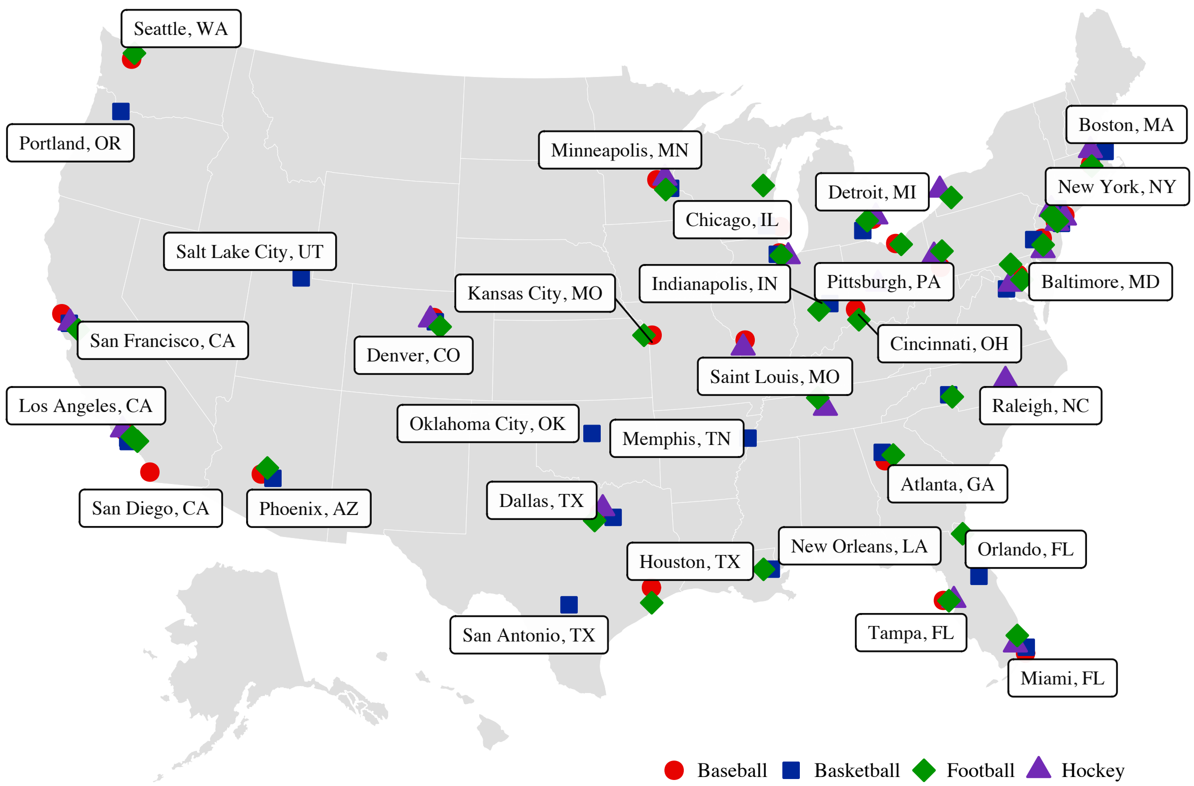

Figure 1: Sample stadiums on the map of the United States, by sport. Small amount of noise was added to the stadiums' coordinates for better clarity.

3km radius, compared with about 3 thousand businesses operating near an average hockey or basketball facility, and 2 thousand businesses near a typical baseball arena. Additionally, Table 1b provides a sectoral breakdown of business establishments within the 3km range from the stadiums. Focusing on the 2-digits NAICS classification[5], we find a substantial presence of businesses related to food & accommodation, retail trade, and health near stadiums. The same business categories are also the most visited ones, as displayed in the right panel of Table 1b. Figure A.5 illustrates the distributional differences in business visits across categories, while Figure A.7 displays variation in average visits across days of the week by industry and sport.

In terms of attendance, football events attract the largest crowds as measured by the SafeGraph visit counts. We observe more than 3,200 SafeGraph visitors on an average football game day, while

[5]We group 2-digit NAICS codes 31, 32 and 33 into a single Manufacturing group; 44 and 44 codes into a retail trade group; 48 and 49 codes into Transportation group; and omit the 11 and 21 codes entirely due to negligible presence in the stadium vicinities.

Sport	Stadiums	Means				Average daily SG visits	
		Games	Area	Capacity	Bus. nearby	No-game day	Game day
Baseball	26	79.8	43,911.1	42,196.5	2,029.7	83.3	1,258.6
Basketball	25	44.9	21,049.9	18,944.8	3,000.3	200.0	612.6
Football	30	8.6	59,743.8	70,625.7	1,316.8	159.8	3,248.5
Hockey	21	43.9	21,357.5	18,292.8	3,082.6	231.5	760.5

(a) Stadium sample summary statistics. 1 stadium is shared by multiple basketball teams. 1 stadium is shared by multiple football teams. 10 stadiums are shared by a basketball and a hockey team. Stadium area measured in square meters. Businesses in a 3 km radius defined as nearby businesses.

Industry	Mean business count within 3km of stadiums				Mean yearly local business visits (thsd.)			
	Baseball	Basketball	Football	Hockey	Baseball	Basketball	Football	Hockey
Admin. Services	6.7	9.7	5.7	9.3	3.5	5.0	3.7	3.3
Construction	0.3	0.3	0.3	0.3	0.1	0.1	0.2	0.1
Education	100.2	127.2	57.5	133.7	175.2	252.7	159.3	253.0
Finance	116.8	160.4	83.3	170.0	39.8	47.2	25.8	53.5
Food & Accommodation	570.7	852.6	373.2	860.4	2453.5	4070.0	1674.8	4207.2
Health	318.6	501.1	218.3	523.5	346.2	467.3	232.6	447.4
Information	43.9	58.0	28.4	61.9	66.7	110.0	48.2	111.6
Manufacturing	15.8	24.8	10.6	25.1	24.9	30.8	16.3	31.2
Other Services	291.5	411.0	173.0	418.0	275.6	317.2	147.6	323.3
Professional Services	28.3	36.8	17.2	37.8	16.3	20.9	8.8	19.0
Public Administration	5.7	8.2	3.1	8.0	11.0	11.7	7.2	10.3
Real Estate	21.0	24.6	16.1	23.2	60.9	63.8	48.1	69.2
Recreation	100.7	158.8	65.0	164.0	471.1	726.6	331.7	776.4
Retail Trade	382.2	587.3	246.1	608.2	1190.4	1647.5	719.7	1714.2
Transportation	21.8	29.7	13.7	30.7	38.5	43.7	26.5	44.5
Wholesale Trade	5.3	9.6	5.2	8.4	5.5	14.0	7.8	11.0
Utilities	0.1	0.2	0.1	0.1	0.1	0.8	0.3	0.4

(b) Summary statisitcs on businesses within 3km of stadiums.

Table 1: Descriptive statistics on stadiums and their vicinities.

basketball & hockey games attract only about 600 and 800 SafeGraph visitors respectively. At the same time, basketball & hockey arenas also display substantial traffic of roughly 200 SafeGraph visitors on no-game days, suggesting that non-sport events hosted by stadiums can generate a flow of potential consumers to the stadium neighborhood. Baseball and football stadiums, which are more popular on the game days compared to basketball & hockey arenas, are less visited when there are no sports events with around 80 and 160 visitors on an average no-game date. Figure A.4 provides an additional illustration of the differences in SafeGraph-measured stadium attendance between game and non-game days, while Figure A.6 shows the variation across days of the week.

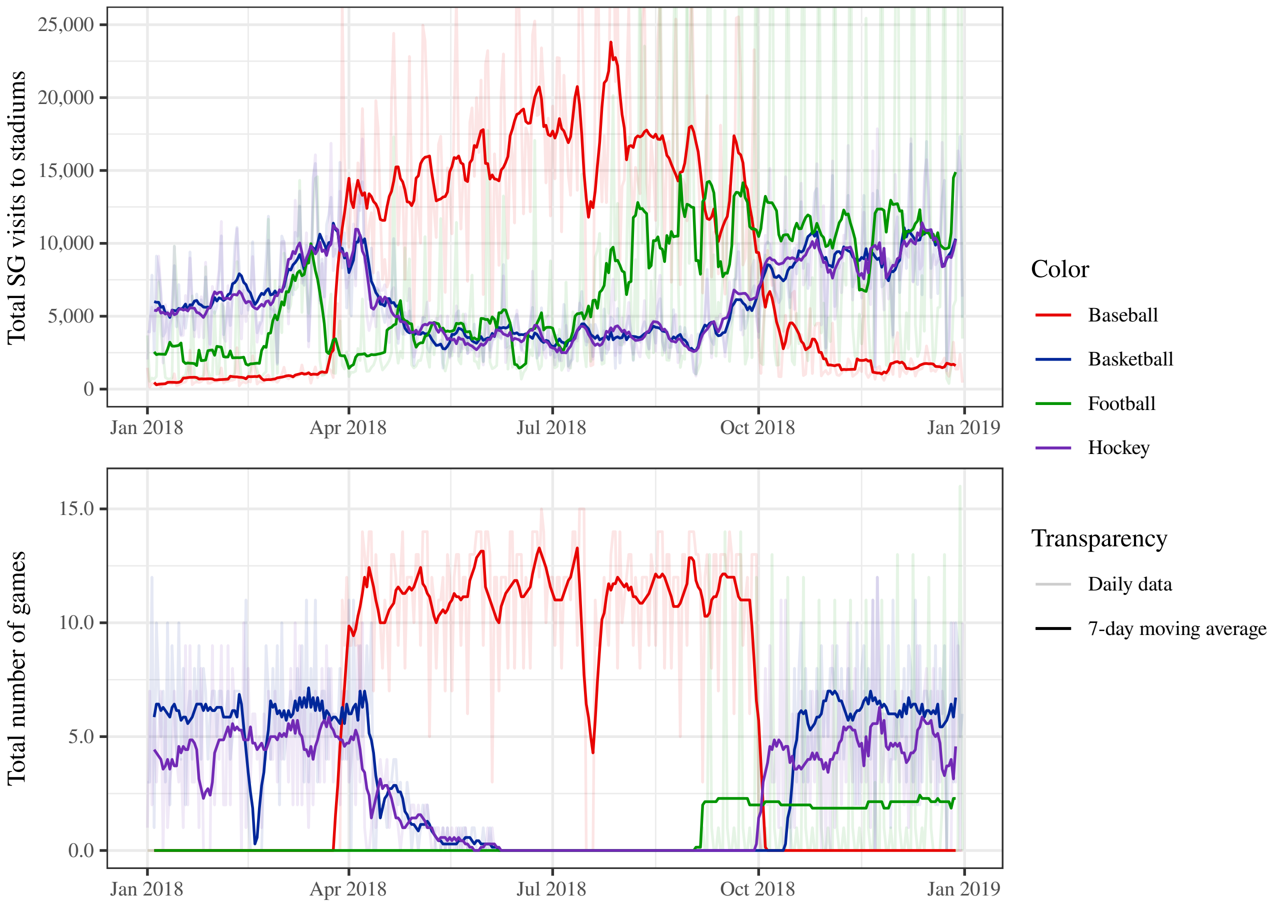

Figure 2: Game events and the corresponding visits inferred from SafeGraph.

While average visits are indicative of the across-sports variation in stadium attendance, temporal variation in visits is key to our empirical strategy of estimating stadium spillover effects.

3.2 Temporal variation

Stadiums host a variety of events from sports games to music concerts to trade shows, events are spread out through the year and are different in attendance, which results in the day-to-day variation in stadium visits measured by SafeGraph and displayed in the upper part of Figure 2. Although the day-to-day stadium visits variation is high, as suggested by the rugged pattern of the transparent lines showing raw total daily visits, the seasonality of visits is also apparent from the bold lines depicting weekly moving averages of total visits. In fact, in line with our expectations, the weekly moving average attendance appears to primarily follow the respective sports seasons displayed in the lower part of Figure 2 by the total daily game count timeline for each sport. At the same time, it should again be noted that stadiums attract substantial crowds even when the sports season is off. For example, the daily total visits to basketball or hockey arenas vary between 2.5 and 5 thousand during the late summer of 2018, when there are no NBA or NHL games. A similar observation can be made for football stadiums and, to a lesser extent, for baseball arenas.

The temporal variation in stadium visits and sports events depicted in Figure 2 is key to our identification strategy. The following subsection explains how we construct our estimation sample.

3.3 Estimation sample

Estimation samples used across the majority of empirical specifications are at the stadium-day level. For each stadium-day observation, we construct total visit counts to nearby businesses as measured by SafeGraph. As mentioned before, each observation also includes information on stadium visits and the indicator of whether the stadium hosted a sports event on a respective day.

While the discussion so far has distinguished between four different sports hosted by the sample stadiums, for the purposes of the estimation we group together the arenas that host basketball & hockey games. There are two reasons for that. First, 10 stadiums in our sample are home to both an NBA and an NHL team playing in the professional leagues. Thus grouping basketball & hockey arenas together allows us to concentrate on spillovers caused by the stadiums, rather than by the respective sports. Second, as evident from the lower part of Figure 2, NBA and NHL seasons parallel each other closely. Thus by looking at basketball & hockey stadiums as a single group, we avoid measurement error in the game date indicator.

Also, we focus our attention on the business categories that display a substantial presence near stadiums according to Table 1b. Thus for estimation purposes, we only consider visits to businesses in 7 sectors: education, finance, food & accommodation, health, other services, recreation and retail trade. To check the coverage of SafeGraph data in these sectors, we cross-verify the establishment counts in SafeGraph and in the Census County Business Patterns datasets. Figure A.3 in the Appendix illustrates the distribution (across the counties in which stadiums are located) of the ratio of SafeGraph business count to the Census business count. For the food & accommodation and retail sectors, the most important ones in our analysis, such ratios are close to 1. The following section describes the empirical specifications that we estimate in order to understand how stadium visits translate into additional visits to businesses in these categories.

4 Empirical strategy and results

Our empirical strategy of estimating spillover effects relies on the day-to-day variation in visits to stadiums and the corresponding variation in visits to nearby businesses. There are several natural reasons to expect a raw positive correlation between stadium visits and local business visits beyond the stadium-generated spillovers. First, there are differences between stadiums in terms of the within-city location. If some stadiums are more accessible to the local population, resulting in higher stadium visits, the same accessibility is likely reflected in higher visits to local businesses. Second, public interest in sports events and in consumption of local goods or services fluctuates from day to day. Observationally, this may again lead to a positive relationship between stadium visits and visits to nearby businesses. Such considerations constitute a threat to the identification of the spillover effects. We first attempt to deal with this threat by estimating the stadium-date level specification that includes the stadium × month × day-of-the-week fixed effect:

$$\text{BusinessVisits}_{dsi} = \beta_{si}\text{StadiumVisits}_{ds} + \gamma_{smwi} + \delta_{di} + \varepsilon_{dsi}, \tag{1}$$

where $\text{BusinessVisits}_{dsi}$ is the sum of visits to businesses in category i near stadium s on date d, $\text{StadiumVisits}_{ds}$ is the observed visit count to stadium s itself on date d, γ_{smwi} is the business category specific stadium × month × day-of-the-week fixed effect, and δ_{di} is the date fixed effect shared by businesses in category i around all stadiums. We estimate eq. (1) separately for each sport of the stadium s and each 2-digits NAICS industry code i of the businesses near stadiums.

Columns (1), (3) and (5) of Table 2 present the resulting estimates. In that table, each coefficient comes from a separate regression estimated on a subset of data. Column groups indicate the sport,

	Dependent varible: business visits within 3km					
	Baseball		Basketball & Hockey		Football	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Food & Accommodation						
Stadium visits	0.3260***	0.2929***	0.7129**	0.1963	0.2890***	0.3978***
	(0.0538)	(0.0612)	(0.2169)	(0.1153)	(0.0436)	(0.0685)
Retail Trade						
Stadium visits	0.0716**	0.0648**	0.1795*	0.0097	0.0868***	0.1258***
	(0.0248)	(0.0228)	(0.0870)	(0.0316)	(0.0147)	(0.0258)
Recreation						
Stadium visits	0.0307	0.0089	0.1058*	−0.0406	0.0703**	0.0663***
	(0.0179)	(0.0226)	(0.0447)	(0.0525)	(0.0228)	(0.0130)
Other Services						
Stadium visits	0.0134**	0.0139*	0.0267**	0.0064	0.0217***	0.0346***
	(0.0037)	(0.0056)	(0.0084)	(0.0079)	(0.0050)	(0.0072)
Health						
Stadium visits	0.0115	0.0092	0.0405*	0.0125	0.0374	0.0617*
	(0.0071)	(0.0075)	(0.0160)	(0.0172)	(0.0237)	(0.0301)
Finance						
Stadium visits	0.0027	0.0015	0.0015	0.0052	0.0040**	0.0060***
	(0.0014)	(0.0013)	(0.0029)	(0.0032)	(0.0012)	(0.0013)
Education						
Stadium visits	−0.0011	−0.0061	0.0120	0.0078	0.0047	0.0216
	(0.0031)	(0.0036)	(0.0062)	(0.0151)	(0.0036)	(0.0117)
Stadium×Month×DoW FE	✓	✓	✓	✓	✓	✓
Date FE	✓	✓	✓	✓	✓	✓
F-stat	-	182.3	-	247.5	-	177.9
1st stage coef.	-	1127.6	-	454.0	-	3122.3
Observations	9,490	9,490	13,140	13,140	10,950	10,950

Note: *p<0.05; **p<0.01; ***p<0.001

Table 2: OLS FE and IV FE estimates. Each coefficient in the table represents an estimate from a regression specification on a subset of data by stadium sport (columns) and business industry (panels). Standard errors robust to heteroskedasticity and stadium and date clustering are reported in parentheses.

by which the data was filtered, with columns (1), (3) and (5) corresponding to football, baseball and basketaball&hockey stadiums respectively. In turn, table panels indicate the industry of the businesses near stadiums that were included in the estimation sample. That is, the coefficient in column s and panel i is the estimate of β_{si}.

For each sport, the stadium visits are strongly correlated with the visits to local food & accommodation businesses. An additional visit to a baseball stadium is associated with 0.3260 additional visits to nearby food & accommodation places. The similar coefficients for basketaball&hockey and football stadiums stand at 0.7129 and 0.2890 respectively. The observed association is lower is substantially lower in magnitude for the retail businesses: an additional stadium visit corresponds to 0.0716 (0.1795, 0.0868) additional retail visits for the case of baseball (basketball & hockey, football). Additionally, visits to recreation facilities appear to be related to basketball & hockey and football stadiums visits, the respective coefficient estimates are 0.1058 and 0.0703 respectively. The remaining fixed effects estimates in columns (1), (3) and (5) of Table 2 are either statistically insignificant or very modest in magnitude. Thus the observed associations between stadium visits and visits to nearby businesses in other services, health, finance and education sectors appear to be negligible.

Although the fixed effects specification is likely to partly resolve the issues preventing the estimation of the true causal spillover effect, some threats to identification remain. First, the demand conditions can vary even for a given stadium, a fixed month and day of the week. If unobserved demand shocks are correlated for the stadium and its vicinity, the fixed-effect specification can overestimate the causal effect of interest. Second, there is a potential concern of reversed causality: if customers of local businesses make last-minute decisions to visit, say, a concert on a stadium, then the coefficients estimated in the FE specifications again do not provide a valid measure of spillover effects, but likely, an overestimate. Finally, since the visits are measured using mobile device location information and some misattribution is inevitable, there is a concern of measurement error in the explanatory variable (stadium visits). Thus, a downward bias in the FE estimate is also not impossible.

To deal with the remaining threats to identification, we employ an instrumental variable strategy, using the sports game date indicator as our instrument. While the game date indicator is likely to be a good predictor of stadium visit counts, it helps to identify the causal spillover effects for three reasons. First, game dates are set well in advance[6] and are thus uncorrelated with demand shocks such as weather or local festivals that drive the public to both stadiums and businesses nearby. Second, using the game date as instrument rules out the reverse-causality argument: again, since game dates are set well before the actual games, they are unlikely to be systematically related to idiosyncratic visits to local businesses (translating to higher stadium attendance). Finally, using the game date instrument solves the measurement error issue.

The game date indicator is a strong predictor of stadium attendance as measured by the SafeGraph sample visit counts across all of the sports groups, as indicated by the first stage estimation results summarized in the lower part of Table 2. Conditional on the stadium × month × day-of-the-week and date fixed effects, game dates are observed to have 1,128 visits more than non-game dates for baseball stadiums. The first stage coefficients for basketball & hockey and football stadiums are 454 and 3,122 additional visits corresponding to game dates. The first stage F statistics stand at 182.3 (247.5, 177.9) for baseball (basketball & hockey, football) visits, suggesting that the game day indicator is a strong instrument.

Columns (2), (4) and (6) of Table 2 present the spillover effect estimates resulting from the instrumental variable specification with the same set of fixed effects as before. These estimates indicate that there exists a strong link between the stadium and local business visits for a subset of sports (baseball and football) and industries (food & accommodation and retail).

Specifically, in line with the fixed effects specifications, for football and baseball stadiums the estimated coefficients indicate a positive spillover effect for food & accommodation and retail businesses. For the most affected food & accommodation industry, 100 additional baseball stadium are estimated to spillover into additional 29.3 business visits, while additional 100 football stadium visits translate into 39.8 additional business visits. Similar estimates for the retail sector stand at 6.5 and 12.5 additional visits for baseball and football stadiums respectively. As in the earlier reported fixed effect

[6] MLB released the 2018 MLB season released on January 9, 2018, more than 2 months before the first scheduled game. A similar gap between the schedule announcement and the season start is observed in NBA, while NHL and NFL announce the schedules even earlier, more than 3 months before the first season game.

specifications, the remaining estimates of baseball stadiums spillovers to recreation, other services, health, finance and education industries are either statistically or economically insignificant[7]. In turn, football stadiums appear to affect nearby businesses across a larger variety of industries. Specifically, 100 additional football stadium visits are estimated to generate 6.63 visits to recreation facilities and 3.46 visits to other services businesses. The 0.0617 coefficient estimate of spillovers generated for health-related businesses is also marginally significant, while the finance and education visits are not substantially affected.

Spillover estimates corresponding to the basketball & hockey stadiums are all rendered insignificant by the instrumental variable strategy. Also, the point estimate for the effect on food & accommodation businesses stands at 0.1963, much lower than the fixed effects approach estimate of 0.7129. A similar note applies to the businesses in the retail sector: the point estimate in the IV specification is only 0.0097, a substantial decline from the FE estimate of 0.1795. These results indicate that the observed association between the stadium and business visits is to the large extent driven by local demand shocks that affect both stadiums attendance and visits to businesses nearby. The IV estimates, which only reflect the variation in the stadium visits driven by sports games, are less likely to reflect the impact of such local demand shocks. This translates into coefficient estimates that are lower in magnitude (compared to the FE estimates) and statistically insignificant.

The decrease in point estimate from the FE to the IV specification is also observed for the businesses near baseball stadiums, once again corroborating the concern that the FE estimates might be biased by the presence of local demand shocks. At the same time, the IV estimates for football spillover effects are higher than the FE estimates, highlighting the possibility that the measurement error is also inducing bias in the observed association between stadium and business visits. Football stadiums, that are anecdotally located in less busy parts of the urban landscape compared to baseball and basketball & hockey arenas, may be less susceptible to the local demand shock bias than to the measurement error. As a result, the football stadiums spillover estimate increases, rather than decreases from the FE to the IV specification.

[7] For the other services sector the coefficient estimate indicates that for 100 additional baseball stadium visits only 1.39 additional business visits are made.

Figure 3: Regression coefficients, estimation sample broken down by distance range around the stadiums.

As a robustness check, we also estimate the spillover coefficients using a subset of data with excluded playoff months for each sport. In those months, game dates are set closer to the actual event, thus potentially increasing the ability of the organizers to adjust to local demand shocks. However, this ability is limited given multiple league-imposed constraints (such as home-ice advantage and alternating host teams in the NHL). Our no-playoff estimates reported in Table A.5 are largely similar to the ones obtained in the main specification indicating the robustness of our results to including playoff months. As an additional robustness check, to account for within-month and day of the week trend in attendance and business visits, we estimate specifications that include a stadium-month-specific time trend. The corresponding estimates presented in Table A.6 are again mostly similar to our preferred estimates.

The spillover effect from stadium to business visits is likely heterogeneous across locations in different proximity to the stadium. To explore this kind of heterogeneity, we also estimate the IV specifications breaking down the affected businesses into distance ranges. Specifically, we compute total visits to businesses in half-kilometer distance bins around the stadiums, ranging from 0-0.5km bin to 2.5-3km bin. We then use these total visit counts as an outcome variable in separate regressions with stadium visits still playing the role of the independent variable. Figure 3 presents the resulting estimates for the two most affected industries, food & accommodation and retail. The patterns of heterogeneity across distance ranges are similar for baseball and basketball & hockey arenas. Most of the generated spillovers affect businesses in the closest proximity to the stadium: the coefficient estimates are significant for the 0-0.5km and 0.5-1km distance ranges in case of food & accommodation businesses, and in the 0-0.5km bin only for the retail businesses. The spillover effects of football stadiums, however, are more spread out: positive spillovers are observed across all explored distance ranges for the food & accommodation industry, and for 0-0.5 to 1.5-2km distance ranges for the retail sector. Still, the effects fade out fast, an additional football stadium visit translates into 0.11 additional food & accommodation visits in the 0-0.5km distance range and only into 0.0226 additional visits in the 2-2.5km distance range.

There is also some evidence of spatial reallocation of consumption. Specifically, the negative (although insignificant) spillover estimates for the businesses located 1-2.5km away from the basketball & hockey arenas indicate that the businesses near stadiums get new customers by stealing them from businesses located further away from the action. We also explored the possibility of temporal reallocation of consumption by aggregating the visits and games data at the weekly level and estimating specifications analogous to those at the daily level using such aggregated data. The results presented in Table A.2 for food & accommodation and retail trade sectors do not point to reallocation: the spillover coefficients for baseball and football stadiums are still positive and significant.

Although the evidence for consumption redistribution we document is relatively weak, we can not rule it out completely. It is possible that businesses near stadiums steal customers from a distance range further than the 3km radius we explore, and detecting such business stealing can be close to impossible if it is spread out across large areas. A similar note of caution applies to temporal redistribution. Finally, the extra spending at businesses near stadiums may actually be reallocated from channels like online consumption on which we don't have any data. We thus conservatively interpret our results as evidence that stadiums do generate traffic for local businesses and think of them as an upper bound on the actual stadium-induced spillovers. For that reason, when we use our estimates to compute the stadium-generated spillovers in the next section, we also interpret this benefits calculation as an upper bound on the actual stadium-induced benefits.

It is important to note that both of our empirical specifications do not allow us to distinguish between the two types of stadium visitors, namely, game-related visitors and other visitors drawn to stadiums for non-game events (such as concerts or trade-shows). This implies that our identification strategy implicitly assumes that the spillover rate from stadium visits into business visits is the same for the game-related and non-game-related visits. Since both types are entertainment-related, it is not too far-fetched to expect them to be similar in the behavior of visitors. Moreover, this assumption enables us to draw the connection between the actual stadium attendance figures and additional visits to nearby businesses on a stadium-by-stadium basis. In comparison, the more common approach in the literature that relies on using a binary indicator of game events as the explanatory variable (see e.g. Coates and Depken, 2011) does not permit this kind of specificity. In turn, the connection between the stadium and business visits allows us to compare the generated spillovers with the stadium subsidies, which is the subject of the next section.

5 Assessing the spillover magnitude

This section provides an additional perspective on the magnitude of consumption benefits generated by stadiums for the businesses in their vicinity. We conduct a simple back-of-the-envelope calculation that puts an upper bound on the benefits local businesses receive from stadium-generated spillovers and compare them head-to-head with the actual subsidies allocated to stadium construction projects. We use the spillover effect estimates, total yearly stadium visit count obtained using total stadium capacity data and a range of assumptions on consumer spending to estimate that a median stadium generates roughly \$12.5M of benefits to the local food & accommodation and retail businesses per year. Thus, we predict that in a median case the gap between the stadium-generated spillovers and the subsidy costs is about 100 million dollars in case of the 30 year average lease duration. Hence, our results indicate that public spending on sports facilities is usually substantially larger than the value of additional consumption they bring to the local businesses.

To evaluate the externality benefits to the local businesses created by the stadiums against the actual amount of public funds distributed to them, we utilize the data provided in Long (2013). In particular, for every stadium in our dataset that was commissioned prior to 2010, we obtained the records of public costs allocated to cover the construction or operation of these facilities. Total public cost is the main variable of interest and corresponds to net present value at 2010 of public capital, net annual ongoing public costs, and foregone property taxes associated with financing and building each facility.

Based on the data from Long (2013), the median value of stadium subsidy in our sample is \$240M (measured in 2010 dollars), also see Figure A.2 for the distribution of the subsidy amount. Correspondingly, for each stadium that received a subsidy we compute the annual externality benefits generated to the local food & accommodation and retail businesses as follows:

$$\text{Est.AnnualBenefits}_s = \text{Est.Attendance}_s \times (\text{DollarPerVisit}_{F\&A} + \text{DollarPerVisit}_{Retail})$$

where

$$\text{DollarPerVisit}_i = \hat{\beta}_{si} \times E$$

is the projected benefit from an additional customer, $\hat{\beta}_{si}$ is the number of additional visits occurring to the businesses in category i for each stadium visitor during game dates (using the results from the first row in Table 2 for each sport category), and E corresponds to the average amount of dollars each generated customer spends on the services of the surrounding businesses. For our baseline, we use the value of $E = \$15$ as a moderate benchmark for comparison. The total annual attendance is

	Mean	Q25	Med.	Q75
All stadiums receiving subsidies				
Annual attendance (m)	2.23	1.69	2.04	2.77
Annual benefits ($M)	11.73	6.96	12.55	15.48
Benefits net of public costs (over 30 years, $M)	-113.37	-169.47	-104.15	-40.95
Public costs at 2010 ($M)	274.80	190.00	240.00	329.00
Baseball				
Annual attendance (m)	2.84	2.56	2.84	2.98
Annual benefits ($M)	15.23	13.76	15.23	16.00
Benefits net of public costs (over 30 years, $M)	-75.19	-154.45	-67.20	12.23
Public costs at 2010 ($M)	284.83	195.00	260.00	374.00
Football				
Annual attendance (m)	1.66	1.30	1.62	1.98
Annual benefits ($M)	13.02	10.21	12.75	15.58
Benefits net of public costs (over 30 years, $M)	-156.12	-217.79	-100.52	-53.53
Public costs at 2010 ($M)	335.33	240.00	285.00	384.00
Hockey & Basketball				
Annual attendance (m)	2.14	1.78	1.98	2.22
Annual benefits ($M)	6.60	5.49	6.11	6.86
Benefits net of public costs (over 30 years, $M)	-112.44	-150.56	-111.59	-70.76
Public costs at 2010 ($M)	203.29	160.00	198.00	235.00

Note: Assuming an average of value of 15$ per generated customer.

Table 3: Public costs and estimated benefits for stadiums receiving public funds.

approximated using the information on stadium capacity, the number of games in 2018, and the average share of visitors who attend the stadium on the days without sports events:[8]

$$\text{Est.Attendance}_s = \text{Est.Attendance}_s^{\textit{game days}} + \text{Est.Attendance}_s^{\textit{other days}}$$

$$\text{Est.Attendance}_s^{\textit{game days}} = \text{TotalGames}_s \times \text{VisitorCapacity}_s \times f_s$$

$$\text{Est.Attendance}_s^{\textit{other days}} = \text{ShareVisitors}_s^{\textit{other days}} \times \text{Est.Attendance}_s^{\textit{game days}}$$

In the above, f_s denotes the average stadium capacity load, which we define separately for each sport category based on the data from Wikipedia.

[8]For each stadium, $\text{ShareVisitors}_s^{\textit{other days}}$ is computed as the stadium's average attendance on no-game days divided by the average attendance on the dates of games, with both estimates obtained from SafeGraph daily visit counts.

Based on our calculations presented in Table 3, a median arena receiving subsidies generates roughly \$12.5M of additional annual value to the businesses in the food & accommodation and retail categories. Notably, baseball stadiums appear to exhibit the most pronounced spillovers with roughly \$15.2M of generated benefits in the median case, followed by football stadiums that generate about \$12.7M. A median hockey or basketball stadium, on the other hand, generates only \$6.1M of benefits, which is in line with the fact that for these sports categories we could not reject the null hypothesis of no external benefits for the surrounding businesses. To offer a more intuitive interpretation of the conducted analysis, for each stadium we also computed *total benefits net of public costs* that is the difference between the total benefits occurring to the existing businesses due to stadium-related visits and the estimated net public costs documented in Long (2013) over the projected stadium's lifespan. To maintain consistency in our calculations, we assume an average lease duration of 30 years and an interest rate of 6 percent following Long (2013).

As follows from the results in Table 3, in the vast majority of cases the allocated subsidies are substantially larger than the projected benefits to the surrounding businesses stadium subsidies appear to generate a substantial loss. Assuming that the average per-consumer spending is \$15, we estimate that a median stadium subsidy leads to a negative total benefits net of public costs of \$104M. Football and hockey & basketball facilities appear to generate a consistent net gap with median total benefits net of public costs of \$100 and \$111M respectively. Notably, baseball stadiums constitute the only category for which we find the upper quartile net benefits to be positive at about \$12.2M. In Table A.3 in the Appendix, we allow for a higher per-customer spending value of \$20 and obtain qualitatively similar results. We find that the upper quartile total benefits net of public costs for hockey and basketball remains negative, a median baseball stadium generates a small net loss, and for football, we find that only the stadiums in the upper quartile generate positive net benefits of \$25M. As another robustness check, Table A.4 in the Appendix replicates Table 3 but with the benefit estimates re-scaled to account for the fact that the total number of businesses in each category covered by SafeGraph can differ systematically from the actual number of businesses in the same category as measured by the Census

County Business Patterns data[9]. The results obtained this way remain very similar to the baseline.

The above results should be interpreted with caution. First, the metrics we use to evaluate the benefits inherit the margin of error from our estimator, which is statistically significant only for the baseball and football stadiums, but not hockey or basketball arenas. Also, as previously mentioned, our local estimates do not account for certain patterns of consumption redistribution and hence should be rather interpreted as upper bounds on the magnitude of the overall spillovers.

Despite the above-mentioned concerns, we think that our results reveal a number of important patterns. First of all, for the vast majority of sports facilities, we find a significant gap between the magnitudes of the subsidies and consumption externalities we estimate from the data. While the largest externality effect we find in Section 4 corresponds to football arenas, these stadiums typically host only a limited number of games each year and, as a result, can not generate enough additional consumption to compensate for the public funds they receive. For basketball & hockey arenas our estimates are not statistically significant and based on the point estimates, we find that they generate the smallest median benefits for the surrounding businesses. And even though baseball stadiums appear to generate the largest additional consumption value due to both consistent attendance and significant externality effects, only the most attended ones seem to be able to generate net benefits after 30 years of the lease.

6 Conclusion

While substantial amounts of public funds have been historically allocated to stadium construction projects on the grounds of potential positive spillover effects stadiums generate for nearby businesses, the lack of detailed data has rendered difficult the task of actually estimating these local spillovers. In this paper we use daily visit counts to major sports league stadiums and local businesses as well as the information on game dates, to estimate such spillover effects. We also explore the heterogeneity of spillover benefits by industries and by distance. Our results indicate that spillovers from baseball and football stadiums are present and concentrated in entertainment-related businesses in the closest proximity to stadiums. However, the local spillover estimates of basketball & hockey arenas are not

[9]Recall the discussion in Section 3 and the corresponding Figure A.3 in the Appendix.

statistically significant. Since our estimates do not account for all redistributional aspects of stadium-generated spillovers, we interpret them as an upper bound on the actual stadium-induced spillovers. Still, our back-of-the-envelope calculations indicate that the median subsidized stadium does not generate enough additional spending for the nearby businesses to offset the subsidies it receives over a typical stadium lifetime.

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Appendix

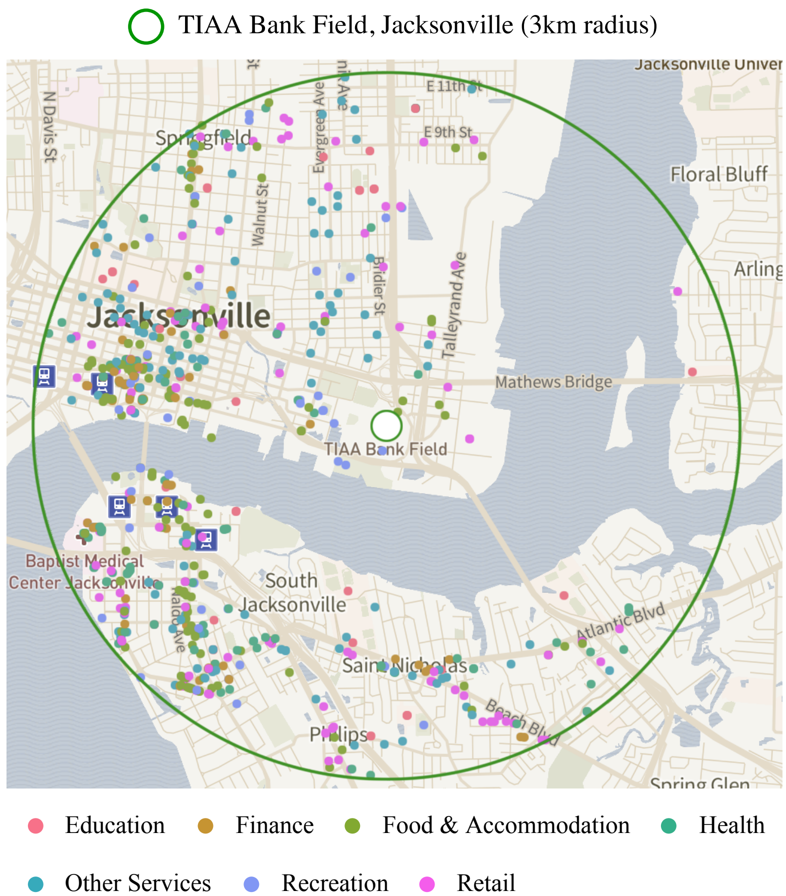

Figure A.1: Establishments by category, in the 3km radius around TIAA Bank Field in Jacksonville, Florida.

	Dependent varible: establishment visits					
	Distance range					
	0-0.5 km	0.5-1 km	1-1.5 km	1.5-2 km	2-2.5 km	2.5-3 km
Football						
FoodAccommodation	0.1100***	0.1436***	0.0619**	0.0386**	0.0226*	0.0150**
	(0.0243)	(0.0266)	(0.0189)	(0.0128)	(0.0101)	(0.0053)
Retail	0.0380**	0.0423***	0.0205**	0.0105**	−0.0017	0.0154
	(0.0124)	(0.0066)	(0.0059)	(0.0031)	(0.0039)	(0.0077)
F-stat	180.9	180.9	180.9	180.9	180.9	180.9
Obs.	10,950	10,950	10,950	10,950	10,950	10,950
Baseball						
FoodAccommodation	0.2208***	0.0395*	0.0195*	0.0140	−0.0059	0.0051
	(0.0361)	(0.0149)	(0.0090)	(0.0114)	(0.0089)	(0.0077)
Retail	0.0526**	0.0085	0.0040	0.0031	−0.0018	−0.0016
	(0.0174)	(0.0049)	(0.0037)	(0.0047)	(0.0045)	(0.0036)
F-stat	190.6	190.6	190.6	190.6	190.6	190.6
Obs.	9,490	9,490	9,490	9,490	9,490	9,490
Basketball & Hockey						
FoodAccommodation	0.2473***	0.0604*	−0.0021	−0.0386	−0.0584	−0.0124
	(0.0420)	(0.0238)	(0.0342)	(0.0370)	(0.0370)	(0.0192)
Retail	0.0605***	0.0016	−0.0118	−0.0065	−0.0377	0.0037
	(0.0157)	(0.0119)	(0.0131)	(0.0078)	(0.0294)	(0.0100)
F-stat	264.5	264.5	264.5	264.5	264.5	264.5
Obs.	13,140	13,140	13,140	13,140	13,140	13,140
Note:				*p<0.05; **p<0.01; ***p<0.001		

Table A.1: IV FE estimates. Each coefficient in the table represents an estimate from a regression specification on a subset of data by distance range (columns), stadium sport (panels) and business industry (rows). All specifications include stadium-month-dayofweek and date fixed effects. Standard errors robust to heteroskedasticity and stadium clustering are reported in parentheses.

	Dependent varible: business visits within 3km					
	Baseball		Basketball & Hockey		Football	
	FE	IV	FE	IV	FE	IV
Food & Accommodation						
Stadium visits	0.2761***	0.2703***	0.8602*	−0.0514	0.3619***	0.6040**
	(0.0611)	(0.0661)	(0.3418)	(0.4734)	(0.0767)	(0.1746)
Retail Trade						
Stadium visits	0.0409	0.0601**	0.1350	−0.2622	0.0924**	0.1648*
	(0.0334)	(0.0199)	(0.1812)	(0.2040)	(0.0284)	(0.0629)
Stadium×Month FE	✓	✓	✓	✓	✓	✓
Week FE	✓	✓	✓	✓	✓	✓
F-stat	-	172.3	-	101.3	-	187.4
1st stage coef.	-	1136.8	-	379.5	-	3213.8
Observations	1,352	1,352	1,872	1,872	1,560	1,560
Note:				*p<0.05; **p<0.01; ***p<0.001		

Table A.2: OLS FE and IV FE estimates with the weekly level of visits aggregation. The number of games during a given week serves as the instrument in the IV specification. Each coefficient in the table represents an estimate from a regression specification on a subset of data by stadium sport (columns) and business industry (panels). Standard errors robust to heteroskedasticity and stadium and week clustering are reported in parentheses.

	Mean	Q25	Med.	Q75
All stadiums receiving subsidies				
Annual attendance (m)	2.23	1.69	2.04	2.77
Annual benefits ($M)	15.64	9.28	16.74	20.64
Benefits net of public costs (over 30 years, $M)	-59.56	-122.87	-55.31	37.02
Public costs at 2010 ($M)	274.80	190.00	240.00	329.00
Baseball				
Annual attendance (m)	2.84	2.56	2.84	2.98
Annual benefits ($M)	20.31	18.35	20.31	21.34
Benefits net of public costs (over 30 years, $M)	-5.31	-86.12	-2.93	81.04
Public costs at 2010 ($M)	284.83	195.00	260.00	374.00
Football				
Annual attendance (m)	1.66	1.30	1.62	1.98
Annual benefits ($M)	17.36	13.61	17.00	20.78
Benefits net of public costs (over 30 years, $M)	-96.38	-180.72	-46.35	25.40
Public costs at 2010 ($M)	335.33	240.00	285.00	384.00
Hockey & Basketball				
Annual attendance (m)	2.14	1.78	1.98	2.22
Annual benefits ($M)	8.80	7.31	8.14	9.15
Benefits net of public costs (over 30 years, $M)	-82.16	-122.41	-83.19	-44.68
Public costs at 2010 ($M)	203.29	160.00	198.00	235.00

Note: Assuming an average of value of 20$ per generated customer.

Table A.3: Public costs and estimated benefits for stadiums receiving public funds (under alternative assumptions).

	Mean	Q25	Med.	Q75
All stadiums receiving subsidies				
Annual attendance (m)	2.23	1.69	2.04	2.77
Annual benefits ($M)	12.87	7.72	13.03	16.50
Benefits net of public costs (over 30 years, $M)	-97.65	-153.72	-99.08	-30.64
Public costs at 2010 ($M)	274.80	190.00	240.00	329.00
Baseball				
Annual attendance (m)	2.84	2.56	2.84	2.98
Annual benefits ($M)	17.27	14.48	16.26	17.88
Benefits net of public costs (over 30 years, $M)	-47.13	-141.36	-52.01	31.58
Public costs at 2010 ($M)	284.83	195.00	260.00	374.00
Football				
Annual attendance (m)	1.66	1.30	1.62	1.98
Annual benefits ($M)	13.78	10.57	13.20	16.26
Benefits net of public costs (over 30 years, $M)	-145.69	-211.47	-79.93	-43.10
Public costs at 2010 ($M)	335.33	240.00	285.00	384.00
Hockey & Basketball				
Annual attendance (m)	2.14	1.78	1.98	2.22
Annual benefits ($M)	7.14	5.96	6.52	7.22
Benefits net of public costs (over 30 years, $M)	-104.95	-128.47	-108.27	-62.29
Public costs at 2010 ($M)	203.29	160.00	198.00	235.00

Note: Assuming an average of value of 15$ per generated customer and with spillover estimates scaled by the ratio of SafeGraph business count to the Census business count for each county and business category.

Table A.4: Public costs and estimated benefits for stadiums receiving public funds (under alternative assumptions).

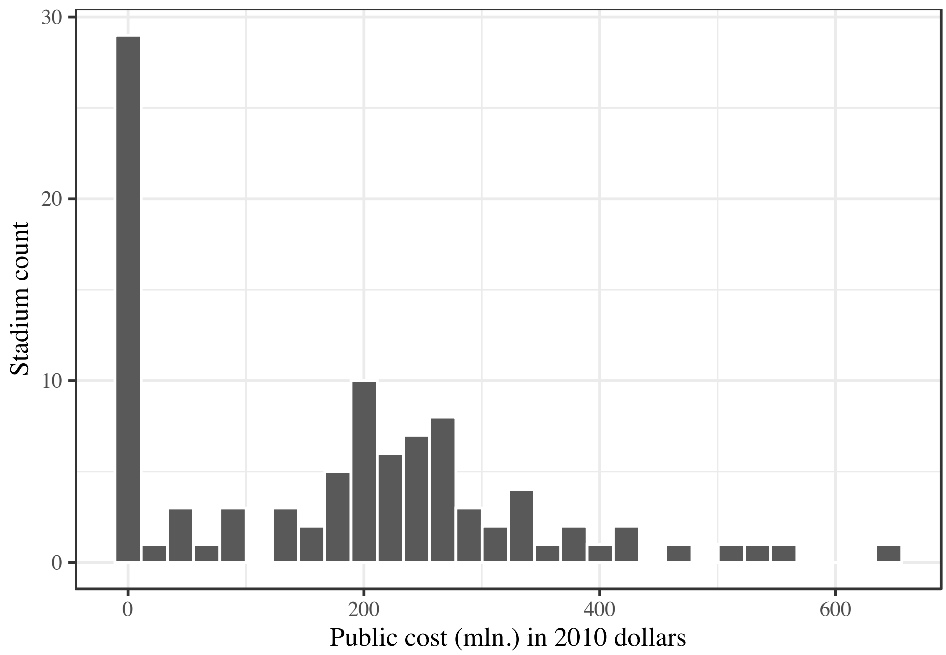

Figure A.2: Distribution of public costs allocated to stadiums.

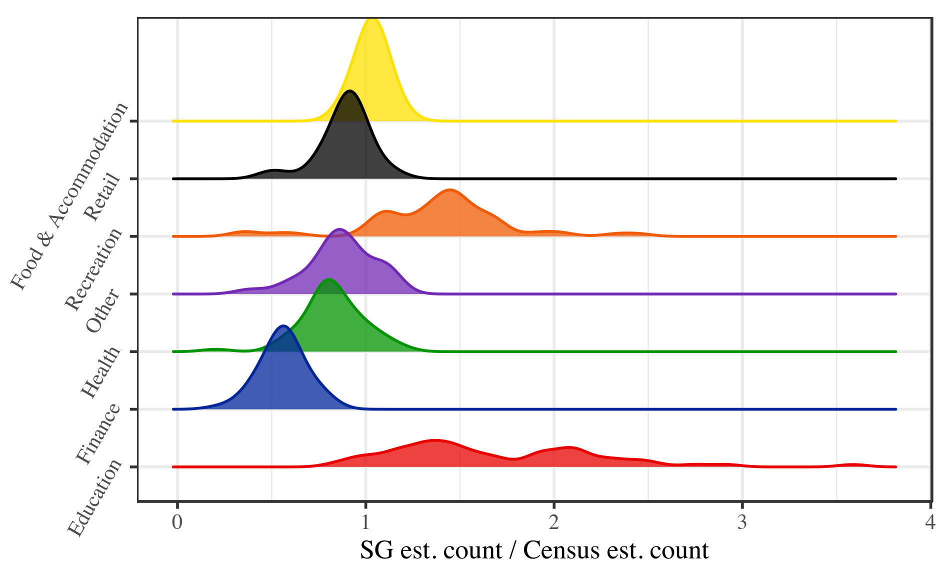

Figure A.3: Coverage of SafeGraph data as compared to the Census County Business Patterns dataset.

	Dependent varible: business visits within 3km					
	Baseball		Basketball & Hockey		Football	
	FE	IV	FE	IV	FE	IV
Food & Accommodation						
Stadium visits	0.3299***	0.2933***	0.8282**	0.2458**	0.2812***	0.3916***
	(0.0491)	(0.0612)	(0.2831)	(0.0894)	(0.0427)	(0.0705)
Retail Trade						
Stadium visits	0.0821***	0.0645**	0.2153*	0.0304	0.0856***	0.1249***
	(0.0215)	(0.0228)	(0.0999)	(0.0279)	(0.0148)	(0.0262)
Recreation						
Stadium visits	0.0318	0.0090	0.1280*	−0.0473	0.0683**	0.0629***
	(0.0189)	(0.0226)	(0.0580)	(0.0561)	(0.0236)	(0.0133)
Other Services						
Stadium visits	0.0127**	0.0140*	0.0318**	0.0097	0.0206***	0.0326***
	(0.0039)	(0.0056)	(0.0107)	(0.0081)	(0.0046)	(0.0066)
Health						
Stadium visits	0.0118	0.0092	0.0538**	0.0200	0.0353	0.0622
	(0.0068)	(0.0076)	(0.0196)	(0.0173)	(0.0225)	(0.0312)
Finance						
Stadium visits	0.0026	0.0015	0.0019	0.0060	0.0040**	0.0059***
	(0.0014)	(0.0013)	(0.0038)	(0.0036)	(0.0012)	(0.0014)
Education						
Stadium visits	−0.0015	−0.0060	0.0182*	0.0147	0.0049	0.0206
	(0.0029)	(0.0036)	(0.0074)	(0.0155)	(0.0038)	(0.0112)
Stadium×Month×DoW FE	✓	✓	✓	✓	✓	✓
Date FE	✓	✓	✓	✓	✓	✓
F-stat	-	182.2	-	255.9	-	173.9
1st stage coef.	-	1127.4	-	417.5	-	3131.1
Observations	8,684	8,684	9,864	9,864	9,180	9,180
Note:						*p<0.05; **p<0.01; ***p<0.001

Table A.5: OLS FE and IV FE estimates without playoff months (Apr-Jun excluded for basketball and hockey, Oct excluded for baseball, Jan-Feb excluded for football). Each coefficient in the table represents an estimate from a regression specification on a subset of data by stadium sport (columns) and business industry (panels). Standard errors robust to heteroskedasticity and stadium and date clustering are reported in parentheses.

	Dependent varible: business visits within 3km					
	Baseball		Basketball & Hockey		Football	
	FE	IV	FE	IV	FE	IV
Food & Accommodation						
Stadium visits	0.3497***	0.3162***	0.7269**	0.2006	0.2817***	0.3891***
	(0.0530)	(0.0621)	(0.2255)	(0.1485)	(0.0453)	(0.0611)
Retail Trade						
Stadium visits	0.0910***	0.0798***	0.1861*	0.0214	0.0878***	0.1198***
	(0.0182)	(0.0212)	(0.0845)	(0.0379)	(0.0156)	(0.0233)
Recreation						
Stadium visits	0.0372*	0.0190	0.1218*	−0.0242	0.0602**	0.0654***
	(0.0176)	(0.0227)	(0.0455)	(0.0559)	(0.0165)	(0.0129)
Other Services						
Stadium visits	0.0170***	0.0183***	0.0304***	0.0103	0.0213***	0.0345***
	(0.0038)	(0.0046)	(0.0082)	(0.0102)	(0.0051)	(0.0072)
Health						
Stadium visits	0.0141*	0.0115	0.0401*	0.0120	0.0399	0.0600*
	(0.0067)	(0.0072)	(0.0149)	(0.0168)	(0.0227)	(0.0276)
Finance						
Stadium visits	0.0030*	0.0021	0.0019	0.0034	0.0042**	0.0062***
	(0.0014)	(0.0012)	(0.0030)	(0.0035)	(0.0012)	(0.0014)
Education						
Stadium visits	0.0029	0.0007	0.0095	−0.0122	0.0038	0.0204
	(0.0024)	(0.0021)	(0.0058)	(0.0137)	(0.0037)	(0.0122)
Stadium×Month×DoW FE	✓	✓	✓	✓	✓	✓
Date FE	✓	✓	✓	✓	✓	✓
Stadium×Month×Day trend	✓	✓	✓	✓	✓	✓
F-stat	-	182.7	-	250.6	-	178.2
1st stage coef.	-	1128.0	-	459.5	-	3134.3
Observations	9,490	9,490	13,140	13,140	10,950	10,950
Note:						*p<0.05; **p<0.01; ***p<0.001

Table A.6: OLS FE and IV FE estimates with stadium-month specific time trend on the daily level. Each coefficient in the table represents an estimate from a regression specification on a subset of data by stadium sport (columns) and business industry (panels). Standard errors robust to heteroskedasticity and stadium and date clustering are reported in parentheses.

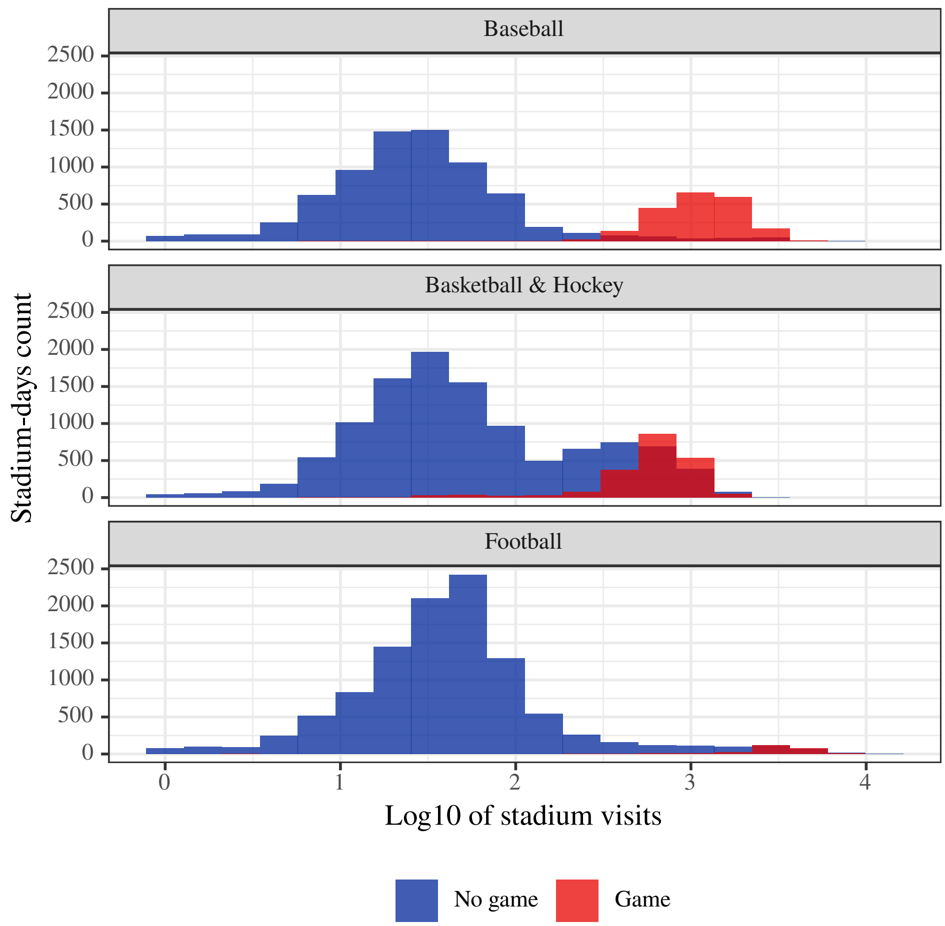

Figure A.4: Distribution of visits to stadiums by sport and game day status. Each observations is a stadium-day.

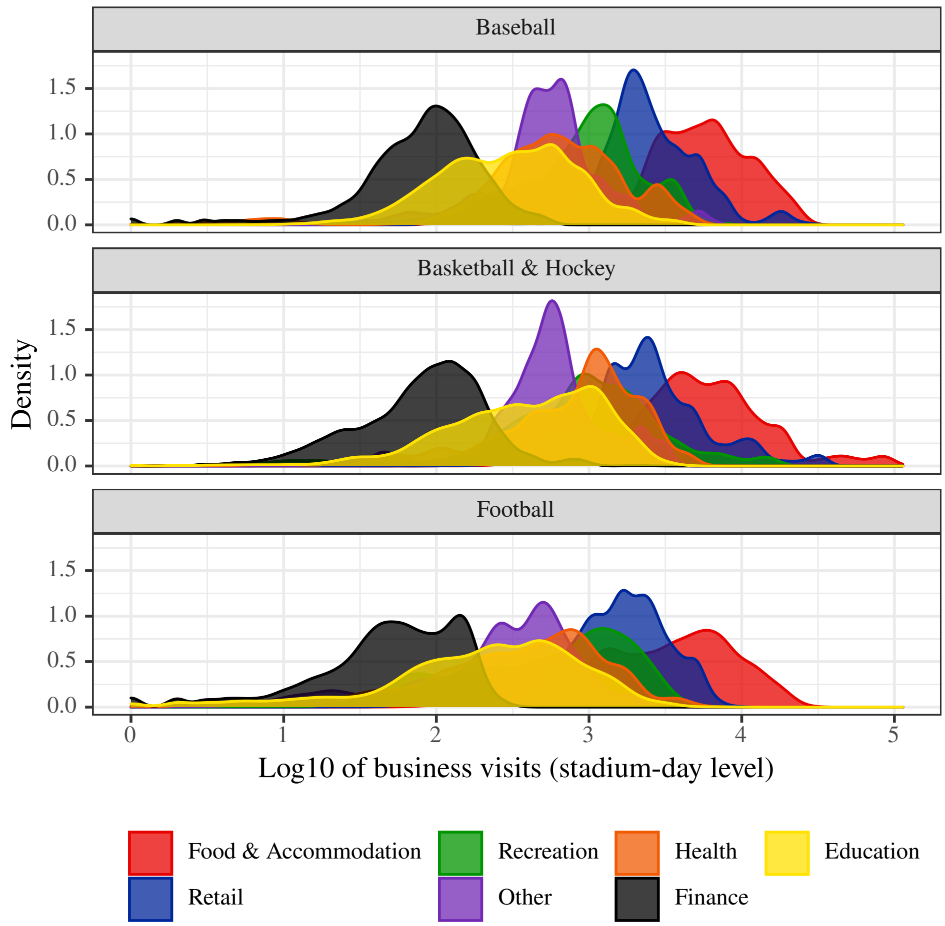

Figure A.5: Distribution of visits to businesses near stadiums by sport and industry. Each observations is a stadium-industry-day.

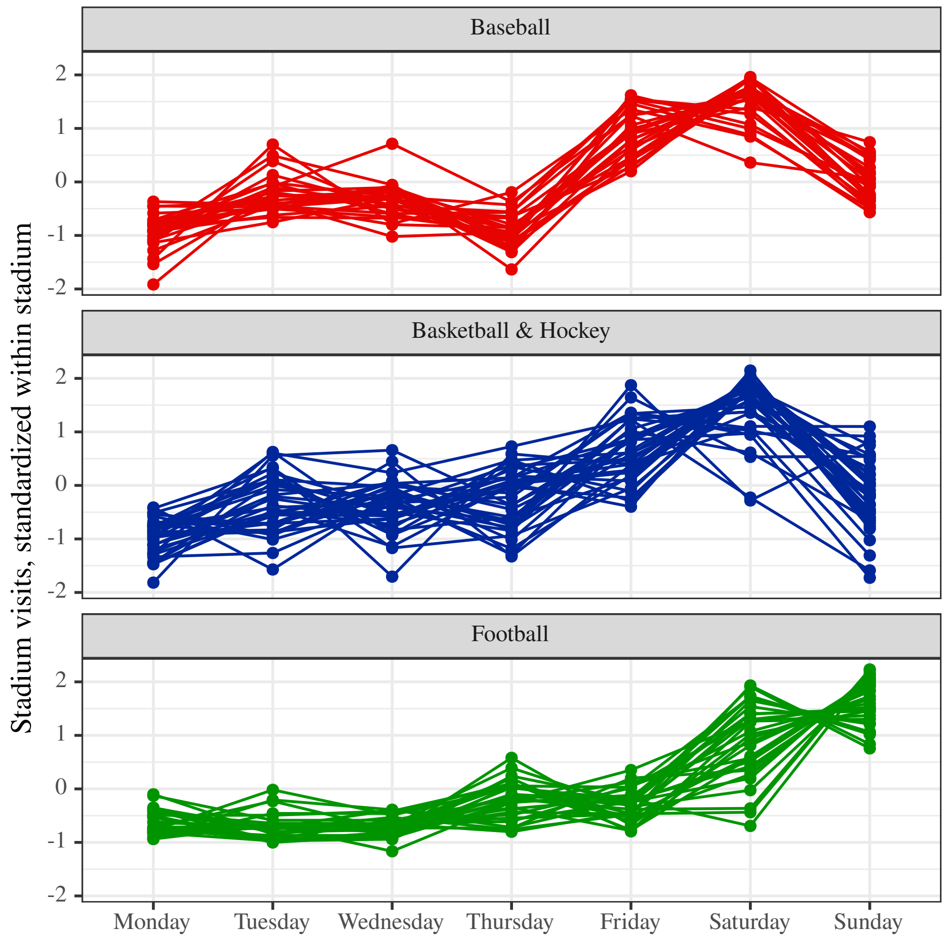

Figure A.6: Comparisons of average visit counts to stadiums across days of the week. Average visit counts standardized within stadiums.

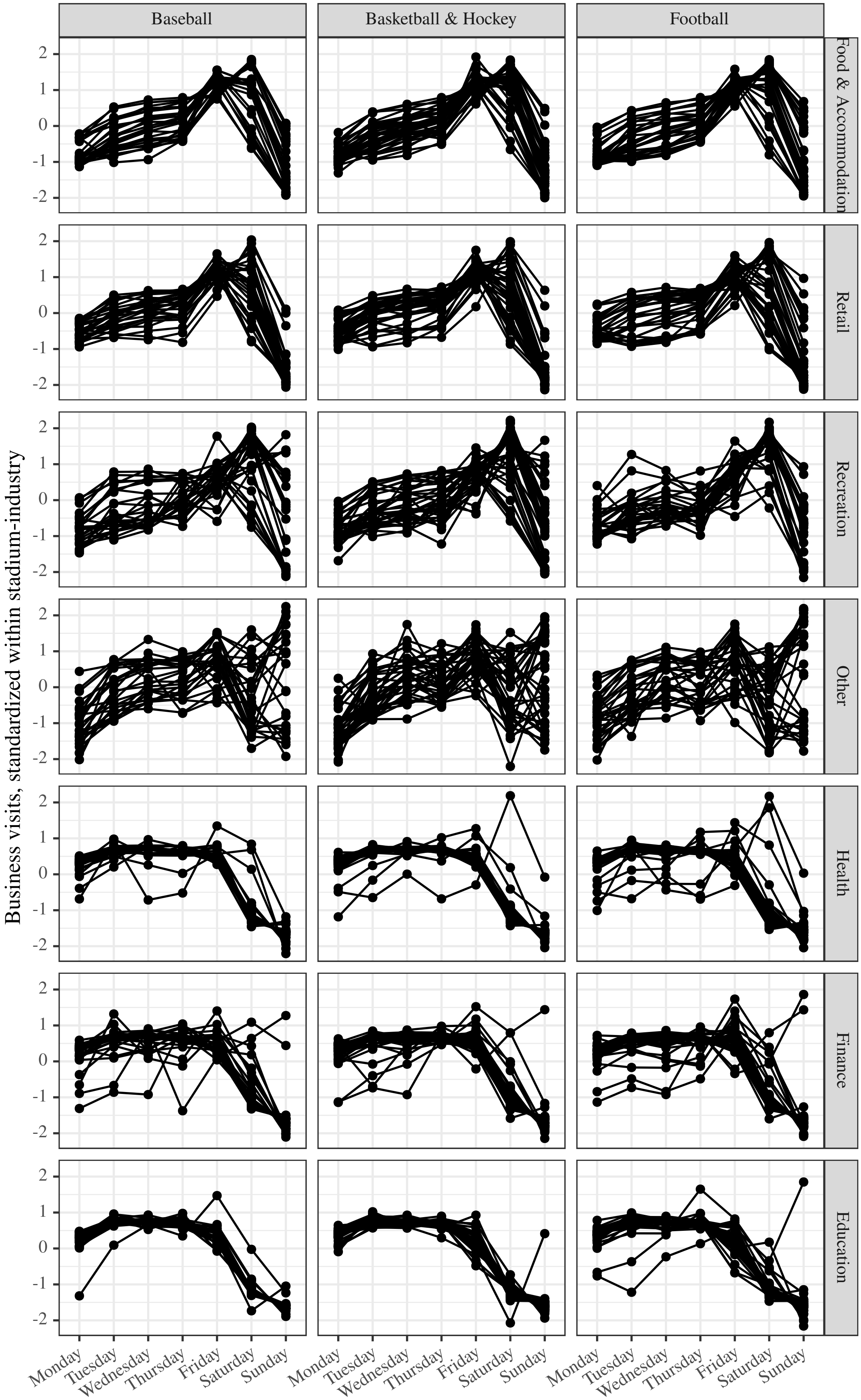

Figure A.7: Comparisons of average visit counts to businesses near stadiums across days of the week. Average visit counts standardized within stadium-industry.

Table A.7: List of all major sports leagues teams and corresponding stadiums. The “Shared” column indicates whether the stadium is shared by multiple teams. The “In sample” column indicates whether the stadium is present in the estimation sample (missingness due to the stadium non-presence in Safegraph data). The “Pub. cost” column indicates whether the data on stadium’s public cost is available in Long (2013).

#	*Team*	*Stadium*	*State*	*City*	*Shared*	*In sample*	*Pub. cost*
Baseball							
1.	Arizona Diamondbacks	Chase Field	AZ	Phoenix		✓	✓
2.	Atlanta Braves	SunTrust Park	GA	Atlanta		✓	
3.	Baltimore Orioles	Oriole Park at Camden Yards	MD	Baltimore		✓	✓
4.	Boston Red Sox	Fenway Park	MA	Boston		✓	✓
5.	Chicago Cubs	Wrigley Field	IL	Chicago			
6.	Chicago White Sox	Guaranteed Rate Field	IL	Chicago		✓	✓
7.	Cincinnati Reds	Great American Ball Park	OH	Cincinnati		✓	✓
8.	Cleveland Indians	Progressive Field	OH	Cleveland		✓	✓
9.	Colorado Rockies	Coors Field	CO	Denver		✓	✓
10.	Detroit Tigers	Comerica Park	MI	Detroit		✓	✓
11.	Houston Astros	Minute Maid Park	TX	Houston		✓	✓
12.	Kansas City Royals	Kauffman Stadium	MO	Kansas City		✓	✓
13.	Los Angeles Angels	Angel Stadium of Anaheim	CA	Anaheim			✓
14.	Los Angeles Dodgers	Dodger Stadium	CA	Los Angeles		✓	✓
15.	Miami Marlins	Marlins Park	FL	Miami		✓	
16.	Milwaukee Brewers	Miller Park	WI	Milwaukee		✓	✓
17.	Minnesota Twins	Target Field	MN	Minneapolis		✓	✓
18.	New York Mets	Citi Field	NY	New York City		✓	✓
19.	New York Yankees	Yankee Stadium	NY	New York City		✓	✓
20.	Oakland Athletics	Oakland Alameda County Coliseum	CA	Oakland	✓		
21.	Philadelphia Phillies	Citizens Bank Park	PA	Philadelphia		✓	✓
22.	Pittsburgh Pirates	PNC Park	PA	Pittsburgh		✓	✓
23.	San Diego Padres	Petco Park	CA	San Diego		✓	✓
24.	San Francisco Giants	AT&T Park	CA	San Francisco		✓	✓
25.	Seattle Mariners	Safeco Field	WA	Seattle		✓	✓
26.	St. Louis Cardinals	Busch Stadium	MO	St. Louis		✓	✓
27.	Tampa Bay Rays	Tropicana Field	FL	St. Petersburg		✓	✓
28.	Texas Rangers	Globe Life Park in Arlington	TX	Arlington		✓	✓
29.	Toronto Blue Jays	Rogers Centre		Toronto			
30.	Washington Nationals	Nationals Park	DC	Washington		✓	✓
Basketball							
31.	Atlanta Hawks	Philips Arena	GA	Atlanta		✓	✓
32.	Boston Celtics	TD Garden	MA	Boston	✓	✓	✓
33.	Brooklyn Nets	Barclays Center	NY	New York City	✓	✓	
34.	Charlotte Hornets	Time Warner Cable Arena	NC	Charlotte		✓	✓
35.	Chicago Bulls	United Center	IL	Chicago	✓	✓	✓
36.	Cleveland Cavaliers	Quicken Loans Arena	OH	Cleveland			✓
37.	Dallas Mavericks	American Airlines Center	TX	Dallas	✓	✓	✓
38.	Denver Nuggets	Pepsi Center	CO	Denver	✓	✓	✓
39.	Detroit Pistons	Little Caesars Arena	MI	Detroit	✓	✓	
40.	Golden State Warriors	Oracle Arena	CA	San Francisco		✓	✓
41.	Houston Rockets	Toyota Center	TX	Houston			
42.	Indiana Pacers	Bankers Life Fieldhouse	IN	Indianapolis		✓	✓
43.	Los Angeles Clippers	Staples Center	CA	Los Angeles	✓	✓	✓
44.	Los Angeles Lakers	Staples Center	CA	Los Angeles	✓	✓	✓
45.	Memphis Grizzlies	FedExForum	TN	Memphis		✓	✓
46.	Miami Heat	American Airlines Arena	FL	Miami		✓	✓
47.	Milwaukee Bucks	BMO Harris Bradley Center	WI	Milwaukee		✓	✓
48.	Minnesota Timberwolves	Target Center	MN	Minneapolis		✓	✓
49.	New Orleans Pelicans	Smoothie King Center	LA	New Orleans		✓	✓
50.	New York Knicks	Madison Square Garden	NY	New York City	✓	✓	✓
51.	Oklahoma City Thunder	Chesapeake Energy Arena	OK	Oklahoma City		✓	✓
52.	Orlando Magic	Amway Center	FL	Orlando		✓	✓
53.	Philadelphia 76ers	Wells Fargo Center	PA	Philadelphia	✓	✓	✓
54.	Phoenix Suns	Talking Stick Resort Arena	AZ	Phoenix		✓	✓
55.	Portland Trail Blazers	Moda Center	OR	Portland		✓	✓
56.	Sacramento Kings	Golden 1 Center	CA	Sacramento			
57.	San Antonio Spurs	AT&T Center	TX	San Antonio		✓	✓

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#	*Team*	*Stadium*	*State*	*City*	*Shared*	*In sample*	*Pub. cost*
58.	Toronto Raptors	Air Canada Centre		Toronto	✓		
59.	Utah Jazz	Vivint Smart Home Arena	UT	Salt Lake City		✓	✓
60.	Washington Wizards	Verizon Center	DC	Washington	✓	✓	✓
Football							
61.	Arizona Cardinals	University of Phoenix Stadium	AZ	Glendale		✓	✓
62.	Atlanta Falcons	Mercedes Benz Stadium	GA	Atlanta		✓	
63.	Baltimore Ravens	M&T Bank Stadium	MD	Baltimore		✓	✓
64.	Buffalo Bills	Ralph Wilson Stadium	NY	Orchard Park		✓	✓
65.	Carolina Panthers	Bank of America Stadium	NC	Charlotte		✓	✓
66.	Chicago Bears	Soldier Field	IL	Chicago		✓	✓
67.	Cincinnati Bengals	Paul Brown Stadium	OH	Cincinnati		✓	✓
68.	Cleveland Browns	FirstEnergy Stadium	OH	Cleveland		✓	✓
69.	Dallas Cowboys	AT&T Stadium	TX	Arlington		✓	✓
70.	Denver Broncos	Sports Authority Field at Mile High	CO	Denver		✓	✓
71.	Detroit Lions	Ford Field	MI	Detroit		✓	✓
72.	Green Bay Packers	Lambeau Field	WI	Green Bay		✓	✓
73.	Houston Texans	NRG Stadium	TX	Houston		✓	✓
74.	Indianapolis Colts	Lucas Oil Stadium	IN	Indianapolis		✓	✓
75.	Jacksonville Jaguars	EverBank Field	FL	Jacksonville		✓	✓
76.	Kansas City Chiefs	Arrowhead Stadium	MO	Kansas City		✓	✓
77.	Los Angeles Chargers	StubHub Center	CA	Inglewood		✓	✓
78.	Los Angeles Rams	Los Angeles Memorial Coliseum	CA	Inglewood		✓	✓
79.	Miami Dolphins	Hard Rock Stadium	FL	Miami Gardens		✓	✓
80.	Minnesota Vikings	US Bank Stadium	MN	Minneapolis		✓	
81.	New England Patriots	Gillette Stadium	MA	Foxborough		✓	✓
82.	New Orleans Saints	Mercedes Benz Superdome	LA	New Orleans		✓	✓
83.	New York Giants	MetLife Stadium	NJ	East Rutherford	✓	✓	✓
84.	New York Jets	MetLife Stadium	NJ	East Rutherford	✓	✓	✓
85.	Oakland Raiders	Oakland Alameda County Coliseum	CA	Oakland	✓		
86.	Philadelphia Eagles	Lincoln Financial Field	PA	Philadelphia		✓	✓
87.	Pittsburgh Steelers	Heinz Field	PA	Pittsburgh		✓	✓
88.	San Francisco 49ers	Levi's Stadium	CA	Santa Clara		✓	
89.	Seattle Seahawks	CenturyLink Field	WA	Seattle		✓	✓
90.	Tampa Bay Buccaneers	Raymond James Stadium	FL	Tampa		✓	✓
91.	Tennessee Titans	Nissan Stadium	TN	Nashville		✓	✓
92.	Washington Redskins	FedExField	MD	Landover		✓	✓
Hockey							
93.	Anaheim Ducks	Honda Center	CA	Anaheim			✓
94.	Arizona Coyotes	Gila River Arena	AZ	Glendale			
95.	Boston Bruins	Td Garden	MA	Boston	✓	✓	✓
96.	Buffalo Sabres	First Niagara Center	NY	Buffalo		✓	✓
97.	Calgary Flames	Scotiabank Saddledome		Calgary			
98.	Carolina Hurricanes	Pnc Arena	NC	Raleigh		✓	✓
99.	Chicago Blackhawks	United Center	IL	Chicago	✓	✓	✓
100.	Colorado Avalanche	Pepsi Center	CO	Denver	✓	✓	✓
101.	Columbus Blue Jackets	Nationwide Arena	OH	Columbus		✓	✓
102.	Dallas Stars	American Airlines Center	TX	Dallas	✓	✓	✓
103.	Detroit Red Wings	Little Caesars Arena	MI	Detroit	✓	✓	
104.	Edmonton Oilers	Rogers Place		Edmonton			
105.	Florida Panthers	Bb&t Cente	FL	Sunrise		✓	✓
106.	Los Angeles Kings	Staples Center	CA	Los Angeles	✓	✓	✓
107.	Minnesota Wild	Xcel Energy Center	MN	Saint Paul		✓	✓
108.	Montreal Canadiens	Bell Centre		Montreal			
109.	Nashville Predators	Bridgestone Arena	TN	Nashville		✓	✓
110.	New Jersey Devils	Prudential Center	NJ	Newark		✓	✓
111.	New York Islanders	Barclays Center	NY	New York City	✓	✓	
112.	New York Rangers	Madison Square Garden	NY	New York City	✓	✓	✓
113.	Ottawa Senators	Canadian Tire Centre		Ottawa			
114.	Philadelphia Flyers	Wells Fargo Center	PA	Philadelphia	✓	✓	✓

Table A.7: List of all major sports leagues teams and corresponding stadiums. The "Shared" column indicates whether the stadium is shared by multiple teams. The "In sample" column indicates whether the stadium is present in the estimation sample (missingness due to the stadium non-presence in Safegraph data). The "Pub. cost" column indicates whether the data on stadium's public cost is available in Long (2013). *(continued)*

#	*Team*	*Stadium*	*State*	*City*	*Shared*	*In sample*	*Pub. cost*
115.	Pittsburgh Penguins	PPG Paints Arena	PA	Pittsburgh		✓	✓
116.	San Jose Sharks	Sap Center at San Jose	CA	San Jose		✓	✓
117.	St. Louis Blues	Scottrade Center	MO	St. Louis		✓	✓
118.	Tampa Bay Lightning	Amalie Arena	FL	Tampa		✓	✓
119.	Toronto Maple Leafs	Air Canada Centre		Toronto	✓		
120.	Vancouver Canucks	Rogers Arena		Vancouver			
121.	Vegas Golden Knights	T-Mobile Arena	NV	Paradise			
122.	Washington Capitals	Verizon Center	DC	Washington	✓	✓	✓
123.	Winnipeg Jets	Bell MTS Place		Winnipeg			