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by

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Abstract

A growing trend throughout the United States is an increasing willingness of cities to publicly finance professional sports stadiums. The stadiums are justified by tangible economic benefits, either citywide or specific to a targeted region through a revitalization plan. The citywide economic impact arising from a new professional sports stadium, when analyzed empirically, has been consistently found to have no statistical significance (Coates and Humphreys, 2000). More recently, empirical work has shifted towards research involving intracity spatial analysis, estimating the differential impact of a stadium by proximity. Research in this avenue has included work conducted by Carlino and Coulson (2004) analyzing rental rates, and Coates and Humphreys (2006) in an analysis of voting patterns. This paper adds to the literature by controlling for trends in alternative stadium locations within the same city, and in estimating local employment growth and business composition change due to a stadium. Using a dataset containing stadiums built from 1996 to 2014, spanning three professional sports leagues (National Football League, Major League Baseball, Class AAA Minor League Baseball), a difference-in-difference approach is used. First, the differential impact on a stadium site is estimated using the city as a whole as the control. Then, the alternative sites are used as the control. A very limited impact is found to occur in the ZIP Code in which a stadium is built when the city is used as a control, with the only estimated impact being an increase in the proportion of eating and drinking establishments by approximately .293 percent. Using the alternative site as a control, no employment or business composition effect is estimated to occur whatsoever. Thus, the findings indicate that the small impact that does occur in the region surrounding a stadium does not outweigh the opportunity cost of the stadium investment.

1 Introduction

In recent years, an influx of new professional sports stadiums has been seen throughout the United States. A notable trend in the development of these stadiums has been an increasing willingness for cities to finance these stadiums publicly. Most often, future economic benefits for the metro area as a whole are cited as the main justification. Baade and Matheson (2012) note that as of 2012, 125 out of the 140 teams comprising the five largest professional sports leagues in the United States played in stadiums constructed or refurbished since 1990. Throughout this timespan, thirty billion dollars (nominal) in construction costs have been spent on such stadiums, over half of which was financed publicly. This does not account for investment in surrounding infrastructure. The ability of a sports team to pressure a city into allocating public funds to support their franchise derives in large part from the increasing popularity of professional sports within our society and a circumstance in which cities bid against one another for scarce teams (Siegfried and Zimbalist, 2000).

Often, cities employ consultants to conduct studies estimating the future economic impact of sports stadiums and facilities. These consultants, not surprisingly, typically forecast net positive impacts for the metro area. Such studies have been highly criticized by economists. Unrealistic assumptions regarding net new spending and associated multipliers are often made that result in misleading conclusions (Siegfried and Zimbalist, 2000). One assumption that causes misleading results is that most of these reports treat all future local expenditure related to the sports stadium as net new spending. This leads to a large error in estimating the true economic impact, because much of this expenditure simply represents a transfer of local consumption away from businesses elsewhere in the metro area. True economic benefits come either from new spending coming from outside the region that otherwise would not entered the metro area, or from spending by local citizens within the area that otherwise would have been spent outside the metro region. It is nearly impossible to differentiate between the variations of expenditure that occur after the construction of a new stadium, which is a problem since impact studies need to count only net new expenditure.

When economists have managed to empirically estimate the net impact on a metropolitan-wide region, the results have been remarkably consistent in showing that little to no net benefit exists for the region as a whole. For example, in measuring the impact of a professional sports environment on real per capita income, Coates and Humphreys (2000) found no positive relationship. Their analysis examined thirty-seven metropolitan areas from the years 1969 to 1996. They found no measurable impact from the arrival of new franchises or construction of a stadium on the growth rate of real per capita income. Siegfried and Zimbalist claim, "Independent work on the economic impact of stadiums and arenas has uniformly found that there is no statistically significant positive correlation between sports facility construction and economic development". Any measurable impact is very localized within a close proximity of the stadium, and even this benefit must be weighed against opportunity cost of the city's investment.

However, more recent work has revealed a new avenue of research involving intracity spatial analysis. This research suggests that residents benefit in accordance to their proximity to the stadium location. Carlino and Coulson (2004) analyzed rental rates in cities hosting teams in the National Football League. They measured rental rates at the city-level, metropolitan statistical area (MSA), and consolidated metropolitan statistical area (CMSA). They found that the presence of an NFL team raised rents on the city-level by 8%, but this effect did not carry over to broader geographic areas. Huang and Humphreys (2014) find new professional sports facilities to be associated with increases in residential mortgage applications. However, they conclude that much of the differential is due to facilities locating in areas that would grow faster even if they were not near a new facility. Work conducted by Coates and Humphreys (2006) also backed the notion of spatial benefits existing in the construction of a sports stadium. In analyzing voting patterns on referendums for professional sports facilities in Green Bay and Houston, the researchers found voters more likely to support the construction of a new stadium as their proximity neared the proposed location. However, precincts immediately near the existing stadium site were more likely to vote against the alternative location. Coates and Humphreys conclude that overall, voting patterns indicated the existence of proximity benefits in the construction of a professional sports stadium, noting that moving forward, researchers would benefit from further exploration of the spatial aspects of sport-related economic benefits.

In line with this research, my study compares the effect of sports stadium construction on different neighborhoods within a city. My analysis adds to the existing work in three ways. First, whereas Carlino and Coulson conduct their analysis on three pre-defined levels of scope for each city, my analysis will measure the impact of stadium construction on a closer, more precise level for each site. Neighborhoods examined will be those immediately surrounding the stadium, regardless of the stadium's location within a metropolitan area. Second, my analysis will measure direct economic impacts through a more diverse range of variables by including business composition as well as employment growth. Prior stadium analyses incorporating these variables only did so on the MSA level, and more recent work that analyzed spatial differences only measured such effects through rental rates. My research will offer a more comprehensive analysis of spatial differences in the impact of stadium construction through the incorporation of multiple economic variables, and in extending the analysis to minor league as well as major league sports.

Finally, my work will better capture the impact of stadium construction by including the alternative locations as controls. The eventually chosen stadium site and alternative locations within the same city generally follow similar economic trends in the years preceding stadium construction. The alternative locations can therefore be seen as valid counterfactuals to the chosen neighborhoods. Given that some alternatives received another investment from the city and others did not, the comparison between sites therefore indicates a conservative estimate of what would have occurred to the chosen stadium site if an alternative project were implemented instead.

Whereas no other stadium analysis has used alternative locations as a control, this approach has been utilized in studies involving other industries. For example, Greenstone, Hornbeck, and Moretti (2010) used alternative locations in their analysis of agglomeration spillovers from large manufacturing plants. This study estimated the positive externalities associated with agglomeration by estimating the impact of opening a large plant on the total factor productivity of incumbent plants in the same county. Total factor productivity was compared between incumbent plants located in the area where the large plant moves in, and plants located in the runner-up county considered for the large plant construction. The identifying assumption is that plants located in "losing" counties form a "valid counterfactual" for plants located in the "winning" counties, as both sets of counties follow similar economic trends in the years before the opening of the new plant. As mentioned previously, the alternative stadium locations in my analysis form a valid counterfactual for the eventually chosen locations.

Analyzing on a more localized level than most prior studies will add insight into a very relevant aspect of the impact of a new sports stadium. The revival of specific neighborhoods is often part of local politicians' overall justification for constructing a stadium. Coates and Humphreys (2011) note that although sports facilities do not appear to generate new economic activity, they do concentrate existing activity towards the proximity of the stadium. Therefore, urban revitalization, as opposed to city-wide tangible benefits, has become the main argument in favor of stadiums made by proponents. The efficacy of such projects in revitalizing specific neighborhoods is a question worth exploring. Additionally, it may be the case that a small impact on the metro area as a whole does exist, yet is concentrated in a very targeted area around the new stadium. This would imply that the goal of revitalization would be fulfilled, not strictly due to redistribution.

Conducting the analysis by first using the entire city and then alternative locations as a control allows the study to address a number of potential questions. First, estimating the differential impact of a stadium on its surrounding neighborhoods compared to the city at large will answer the basic question of whether any measurable effect exists within the local region. Next, the if local benefits are found in the area surrounding a new stadium, the opportunity cost of the city's investment must be considered as well. A number of the alternative locations in the dataset, although they did not receive a stadium, received development of another form. This includes the construction of casinos, convention centers, new shopping complexes, and other similar projects. Thus, using the alternative sites as a control group extends the analysis past the initial question of whether a tangible benefit exists in the construction of a stadium, to answering whether this form of investment offers the greatest return.

In answering the question of whether a stadium offers the greatest return, another issue that often arises in economic impact studies will be addressed. Often, it is hard to distinguish between instances when a stadium or team is the catalyst for local growth, or if the stadium is constructed as a byproduct of already ongoing development within a neighborhood. If the latter is true, then even the very immediate, localized impact accompanying a stadium may not be strictly due to the stadium itself. Comparing neighborhoods that host a new stadium with neighborhoods that receive alternative development provides insight into the extent to which changes within a neighborhood are attributable to just the stadium. If both locations experience changes during the time period under consideration due to underlying new development, it becomes easier to differentiate stadium-influenced growth from growth that would have occurred otherwise.

My analysis looks at stadiums spanning three professional sports leagues. Stadiums hosting teams participating in Major League Baseball and the National Football League were chosen due to the fact that these leagues' stadiums are generally the most expensive out of all professional sports leagues in the United States. From 1995 to 2014, twenty-five NFL stadiums were newly constructed, on average costing $496.9 million in constant 2010 dollars (Barrett Sports Group, 2010). Approximately 54.6% of this was paid for publicly. Since 2000, the average cost of NFL or MLB stadiums totaled over $500 million, whereas stadiums constructed for the National Hockey League (NHL) or the National Basketball Association averaged around $280 million (Santo and Gerard, 2010). Minor League Baseball stadiums were included due to the fact that less analysis has been conducted previously on such stadiums, and Minor League Baseball stadium construction is a topic increasingly affecting small to mid-size cities. Since 2000, sixteen stadiums have been constructed on the AAA level alone. Though these stadiums are smaller in scale than those for the MLB or NFL, they most often represent an important role in their respective communities' economies.

2 Empirical Framework

To estimate the impact of a sports stadium on the local region, a difference-in-difference model is utilized. The model assigns the stadium site as the treatment group, and either the city as a whole or the alternative location as the control. The stadium and alternatives are defined on the ZIP code level, and the city is an aggregation of multiple ZIP codes. Two different dependent variables are tested, one being the percent change in employment in site i in year t, the other being the proportion of eating and drinking establishments to total establishments in site *i* in year *t*. The first series of tests uses the overarching city as the control group to estimate whether any tangible benefit is gained in the stadium site, and the second series of tests uses the alternatives as controls to account for the opportunity cost of investing in a stadium.

The baseline model estimates the economic impact of a stadium using equation (1) as follows:

$$y = \beta_1 + \beta_2(\text{Trend}) + \beta_3(\text{Post*Stadium}) + \beta_6(\text{Post*Trend}) + \beta_7(\text{Post*Trend*Stadium})$$

which is visualized in graph 1, shown in the Appendix. The trend variable is a time trend ranging from three years prior to stadium construction to three years after, measuring a common time effect for both the control and treatment sites. The stadium dummy variable indicates whether or not a site is the stadium recipient. The final independent variable is a binary dummy that indicates whether an observation occurs in or after year 0, the opening year of the stadium.

In this model, the treatment and control groups follow a common time trend, β_2, prior to year zero. This common trend assumes no significant difference between the stadium and control location preceding the opening of a stadium. In year zero, an instantaneous shift within the treatment (stadium) group is estimated by the β_3 coefficient. In all years greater than or equal to year zero, the time trend for the control group is calculated as $\beta_2+\beta_6$, and the time trend for the treatment is $\beta_2+\beta_6+\beta_7$. Thus**,** the differential time trend for the treatment group over the control is estimated by β_7.

The first variant of the baseline model removes the differential time trend after stadium construction, and is presented below:

$$y = \beta_1 + \beta_2(\text{Trend}) + \beta_3(\text{Post*Stadium}) + \beta_6(\text{Post*Trend}) \quad (2)$$

where β_3 now becomes the only component of the estimation that differs between the control and treatment groups. A visualization of the model is shown in graph 2. The rational behind this variant is that the proportion of eating and drinking establishments and change in employment may not continue to experience a differential impact from a stadium after the initial year that the stadium opens. For example, if the proportion of restaurants and bars experiences an initial jump from .05 to .08, it is likely that this proportion would not continue increase as time wears on, or would experience diminishing returns.

To address the potential of diminishing returns on a local economy through time, a second variant is tested, estimating the impact of a stadium in yearly steps:

$$y = \beta_1 + \beta_2(\text{Trend}) + \beta_3(\text{Year0*Stadium}) + \beta_4(\text{Year1*Stadium}) + \beta_5(\text{Year2*Stadium}) + \beta_6(\text{Post*Trend}) \quad (3)$$

In this model, three single-year dummy variables are interacted with the stadium dummy. The year zero variable is equal to one if and only if the year of a given observation is year zero. The same logic applies to the year one and year two dummies. As can be seen in graph 3, this model estimates the impact of a stadium on the local region with three yearly steps. If diminishing returns are found to exist, the estimated magnitude of β_3 will be larger than β_4, and β_4 will correspondingly be of greater magnitude than β_5.

3 Data

My dataset includes forty-eight stadiums constructed from the years 1996 through 2014. The forty-eight stadiums can be separated into three distinct contexts in which the construction projects occurred. First, a new stadium is often constructed on the same site as the team's prior stadium. Next, in the instance of a move within the same city, the stadium will be built in a different ZIP code than its prior location. Finally, a team might be introduced into a city for the first time altogether. For my empirical analysis, all stadiums that were constructed on the same site as before were excluded, bringing the baseline number of stadiums down to twenty-seven. These stadiums are excluded because their respective neighborhoods should not be expected to experience a great shock economically if a stadium already existed within the neighborhood in the past.

Corresponding with the twenty-seven stadium sites, twenty-seven cities and thirty-three alternative locations are included in the dataset. The stadiums, respective cities, and years of opening were obtained through websites such as BaseballAmerica.com and StadiumsofProFootball.com. No previous dataset exists that contains information regarding alternative stadium sties, making the dataset created for this analysis the first of its kind. Alternative locations were discovered through historical newspaper articles, press releases, and transcripts found through multiple search engines, including LexisNexis. Once an alternative location was discovered, its coordinates and corresponding ZIP code were searched through Google Maps.

Within the locations analyzed, employment and industry detail data were obtained through the United States Census Bureau County Business Patterns database. Data is available at the ZIP code level, and for the analysis, city-wide measures were calculated as an aggregation of the ZIP code data. Eating and drinking establishments are defined by SIC code for observations preceding 1998, and matched according to NAICS code for observations in 1998 onward. The initial set of SIC codes that are matched through time include "Eating Places (5812)", "Retail Bakeries (5461)", "Direct Selling Establishments (5963)", and "Drinking Places, alcoholic beverages (5813)". The set of SIC codes were chosen as a broad representation of eating and drinking establishments as to allow for the most accurate matching through time.

A few notable trends stand out from the summary statistics. Thirteen stadiums within the dataset were constructed to host a Minor League Baseball team, seven were constructed for a Major League Baseball team, and seven for a National Football League team. Twenty stadiums possess at least one alternative location, with the mean number of alternatives being 1.19. Average employment growth in stadium locations and their alternative sites ranges from -1.6 percent to 3.6 percent from years *t*-3 to *t*+3 (*t* representing the year a stadium opens). The mean proportion of eating and drinking establishments to total establishments ranges from 2.6 percent to 3.2 percent, and thus does not vary greatly across observations. In absolute terms, the mean number of eating and drinking establishments in a stadium's ZIP code ranges from 87.31 to 100.64, and for an alternative site ranges from 72.39 to 80.46. Summary statistics are reported in the Appendix in Tables 1-7.

4 Empirical Results

In the first round of empirical testing, employment growth and the proportion of eating and drinking establishments are estimated at the stadium site, using the city as a whole as the control. Table 8 presents the results of estimating employment growth. The first column shows the results of the estimation using equation (1), the second column shows the results of equation (2), and the third column shows the results using equation (3). In all three models tested, none of the coefficients specific to the stadium site show statistical significance. In fact, the only variable that shows any significance is the general time trend in equation (3), which is negative and significant at the 10% level. Overall, no differentiable impact on employment growth is found to occur at the stadium site compared to the city as a whole.

Table 9 shows the results of estimating the proportion of eating and drinking establishments to all establishments, using the same three equations. No variables are found to be significant when using the baseline model, but when the stadium-specific time trend is removed, β_3 (the new stadium-specific intercept at t=0) becomes significant at the 1% level and has a value of .00293. This implies that in the year that a stadium opens, the stadium site is estimated to experience an instantaneous increase in the proportion of eating and drinking establishments by approximately .293 percentage points. This model has a slightly higher adjusted R-squared than the baseline equation, implying a better fit. Finally, when the third model is estimated, only the common time trend is found to be statistically significant. Although none of the step variable coefficients are statistically significant, the year zero coefficient is positive with a magnitude of .00151, and a standard error of .0169. Thus, given that in the second model the new intercept was found to be .00293, it is quite possible that the true coefficient of the year zero coefficient is similar in magnitude to that of the coefficient found in the second model. In any case, based on the results of model B, it appears as though some small business composition change does occur in the stadium site when compared to the city as a whole.

These results imply that only a very limited economic impact is estimated within the ZIP code of a new stadium when compared to the entire city. No impact on employment is estimated to occur, and the stadium location is predicted to experience an increase in the proportion of restaurants and bars, by about .293 percent. With the mean number of total establishments within a stadium's ZIP code being 3,335, this equates to an increase of approximately 9.77 restaurants and bars. It is difficult to make a value judgment regarding this change in business composition, as the empirical testing does not show which industries leave

Table 8: Employment Growth Estimation, Using City as Control

	Change in Employment		
	Model A	Model B	Model C
Trend	-.0047 (0.01216)	.03456 (.02421)	-.00666* (.003676)
Post*Stadium	-.0173 (.07056)	-.00306 (.01149)	
Post*Trend	-.00147 (.00856)	-.00227 (.00833)	
Post*Trend*Stadium	.00531 (.01275)		
Year0*Stadium			-.01757 (.02722)
Year1*Stadium			.02849 (.0276)
Year2*Stadium			.03375 (.02845)
n	294	294	294
Adjusted R-Squared	-0.00493	0.001137	0.003074

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

Table 9: Proportion of Eating and Drinking Establishments Estimation, Using City as Control

	Proportion of Eating and Drinking Establishments to Total Establishments		
	Model A	Model B	Model C
Trend	.00046 (.0005)	.00031 (.0005)	.00057** (.00057)
Post*Stadium	.00202 (.00171)	.00293*** (.00109)	
Post*Trend	-.00027 (.00105)	.00017 (.00084)	
Post*Trend*Stadium	.00066 (.00095)		
Year0*Stadium			.00151 (.0169)
Year1*Stadium			.00266 (.00171)
Year2*Stadium			.00243 (.00177)
n	294	294	294
Adjusted R-Squared	0.04745	0.04916	0.03619

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

the stadium site in correspondence with the increase in restaurants and bars. With such a small change estimated to occur in the stadium's location, it is important to consider the opportunity cost of the city's stadium investment. This is addressed in the second round of empirical testing, which uses the alternative locations as the control group.

Table 10 shows the results when employment growth is estimated at the stadium location, using the alternative locations as the control. As in the prior tests, models A, B, and C correspond with equations (1), (2), and (3), respectively. In all three models tested, no coefficient is found to be statistically significant, implying no difference in employment growth between the stadium site and alternative location. Table 11 presents the results in estimating the proportion of eating and drinking establishments around the stadium compared to the alternative location. In the first two estimated equations, no variable is found to be statistically significant. In estimating equation (3), only the common time trend is significant. The results imply that a sports stadium has no business composition effect on a stadium location when compared to its alternative location.

The findings when using the alternative locations as a control show that stadium construction is no more effective than any other form of treatment in revitalizing or changing the economic composition of a region. In fact, building a stadium may be worse than an alternative project, as not every alternative in the dataset received another investment from the city. The true impact of an alternative treatment is thus underestimated in these results, further supporting the notion that a stadium investment is difficult to justify quantitatively.

Table 10: Employment Growth Estimation, Using Alternative Sites as Control

	Change in Employment		
	Model A	Model B	Model C
Trend	-.00112 (.01193)	-.00063 (.01185)	-.00573 (.00377)
Post*Stadium	.01255 (.02502)	.01818 (.02068)	
Post*Trend	-.00433 (.00909)	-.00453 (.00902)	
Post*Trend*Stadium	.00163 (.004077)		
Year0*Stadium			-.01384 (.0279)
Year1*Stadium			.03130 (.02829)
Year2*Stadium			.03563 (.02916)
n	294	294	294
Adjusted R-Squared	-0.00638	-0.00347	0.00026

Table 11: Proportion of Eating and Drinking Establishments, Using Alternative Sites as Control

	Proportion of Eating and Drinking Establishments to Total Establishments		
	Model A	Model B	Model C
Trend	.00064 (.00096)	.00062 (.00091)	.00091*** (.00029)
Post*Stadium	-.00140 (.00578)	-.0019 (.00145)	
Post*Trend	0.0003 (.00068)	.00032 (.00066)	
Post*Trend*Stadium	-.00009 (.00104)		
Year0*Stadium			-.0016 (.00225)
Year1*Stadium			-.00079 .00227
Year2*Stadium			-.00136 (.00234)
n	315	315	315
Adjusted R-Squared	0.02246	0.02558	0.01966

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

5 Sensitivity Analysis/Robustness

The robustness of the results in Section 4 is estimated by running separate regressions that separate minor league and major league sports stadiums. Specifically, the same tests as above are run, with the only exception being that NFL and MLB stadiums are now collectively treated as the treatment group, and Minor League Baseball stadiums are included in the control group alongside the city or alternatives. The purpose of these tests is to determine whether the true economic impact of a major league sports stadium is underestimated when including minor league stadiums in the treatment group as in Section 4, in which case a positive and statistically significant relationship may be found by removing minor league stadiums from the treatment. Stadiums built for NFL and MLB teams are generally much larger and more expensive than minor league stadiums, it is possible that these stadiums would be found to have a larger effect on their respective ZIP codes.

Table 12, shown in the Appendix, presents the results of estimating employment growth when using NFL and MLB stadiums as the treatment group, and Minor League Baseball stadiums and the city as a whole as the control group. When equation (2) is tested, an instantaneous increase in employment growth during the year a stadium opens is estimated to occur at the stadium site, by approximately 4.033 percentage points. This coefficient is significant at the 10% level. The coefficients estimated from testing equation (3) show a 9.47 percentage point increase in employment growth estimated to occur in the second year after a stadium opens. Based on these results, it initially seems apparent that the original tests for employment growth severely underestimated the employment impact of opening a major league sports stadium. However, further testing shows that these new results are driven largely by two observations alone, and that once these two observations are removed the original estimates prove to be robust.

The two observations that are found to be outliers when estimating employment growth in major league stadiums are University of Phoenix Stadium in year *t+1* and Target Field in year *t+2*. These stadiums experienced employment growth of 93.84% and 90.52%, respectively. When these stadiums are included, the average employment growth in years *t+1* and *t+2* for major league stadiums are 8.57% and 6.08%. Once the two observations are removed, the averages become 1.47% and -1.59%, respectively. Such large magnitudes may be found to exist for University of Phoenix Stadium and Target Field due to geographically small ZIP code sizes that do not include much square footage beyond the stadiums. Table 13, also in the Appendix, shows the results once these two observations are removed. No statistically significant employment impact is estimated in the major league stadium site when compared to the control group. Thus, the original findings in Section 4 comparing employment growth in stadium sites to the city as a whole are found to be robust.

Table 14 shows the results of estimating the proportion of eating and drinking establishments to total establishments in an NFL or MLB stadium site. Again, AAA Minor League Baseball stadium sites and the entire city are used as the control group. The results largely mirror those of the original estimation in Section 4. Whereas the original test for equation (2) estimated an increase in year zero in the proportion of eating and drinking places by .293 percentage points, this coefficient has now increased to .0039 (representing a .39 percentage point increase) and is still significant at the 1% level. In estimating equation (3), an impact in year two is now estimated to occur, by a magnitude of .4 percentage points, and is statistically significant at the 10% level. Overall, the results are found to be very similar to those found when including minor league stadiums in the treatment group.

Finally, Tables 15 and 16 present the results of testing both dependent variables when using MLB and NFL stadium locations as the treatment, and alternative sites and minor league stadiums as the control. In these tests, no stadium-specific coefficient is found to be statistically significant. This indicates that even for a larger, more expensive stadium such as those constructed for Major League Baseball and National Football League teams, no differential impact is estimated to occur in terms of employment growth or business composition when the stadium site is compared to alternative sites and smaller stadium projects. The results presented in Section 4 are thus found to be robust to all tests when the treatment group is restricted to just MLB and NFL stadiums.

6 Conclusion

A difference-in-difference approach was used to estimate the differential economic impact of a sports stadium on its immediately surrounding region, with the city as a whole and then alternative stadium locations serving as the control. The economic impact was measured through business composition change, specifically the proportion of eating and drinking establishments to total establishments, as well as employment growth. The empirical results show that no employment effect occurs in a stadium site when controlling for employment growth in the whole city, and a small business composition effect is found to exist. The model estimates that using the city as the control, a stadium increases the proportion of eating and drinking establishments in its ZIP code by .293 percentage points, or, on average, 9.77 establishments. It is not tested, however, which industries leave a region when a stadium is built.

When the alternative locations are used as the control group, neither a business composition or employment effect are found to exist within the stadium's ZIP code. This finding is important because it provides insight into the opportunity cost of stadium construction. Given that the alternative locations were considered for but did not receive the stadium investment, the fact that no quantitative difference is found to exist between alternatives and the stadium site implies that the stadium investment is, at best, no better than other forms of treatment.

Many of the alternatives did not receive any project whatsoever. Thus, the true impact that can be expected from an alternative investment is underestimated in the findings, leading to the conclusion that a stadium investment is likely worse than other forms of treatment in revitalizing a region. Given that the justification for publicly funding a stadium has shifted away from city-wide benefits and towards targeted neighborhood revitalization plans, this finding is very relevant from a public-policy standpoint. It is worth noting that nontangible benefits, such as national prestige and pride, are common reasons for an individual to support stadium construction. Still, for a city attempting to gain taxpayer support for a stadium investment often worth over half a billion dollars, these effects are much more difficult to sell.

One limitation of this paper is that although an increase in the proportion of restaurants and bars at the stadium site was found when using the city as the control, the study did not attempt to discover which industries moved away from the stadium region. Further research addressing this question would be valuable. Additionally, it would be useful run the analysis with an expanded dataset containing additional alternative locations, restricted to those receiving an alternative investment. This would provide a more complete understanding of the true opportunity cost of a stadium investment. Finally, it would be useful to look at additional variables beyond business composition and employment growth. With stadium construction often used as a form of gentrification, it would be of value to study income inequality and demographic effects, as gentrification often faces criticism on both of these fronts. For a city undergoing a stadium investment, it is crucial that the estimated impact is fully understood, and thus it is advisable to consider a full range of variables, both demographic and economic.

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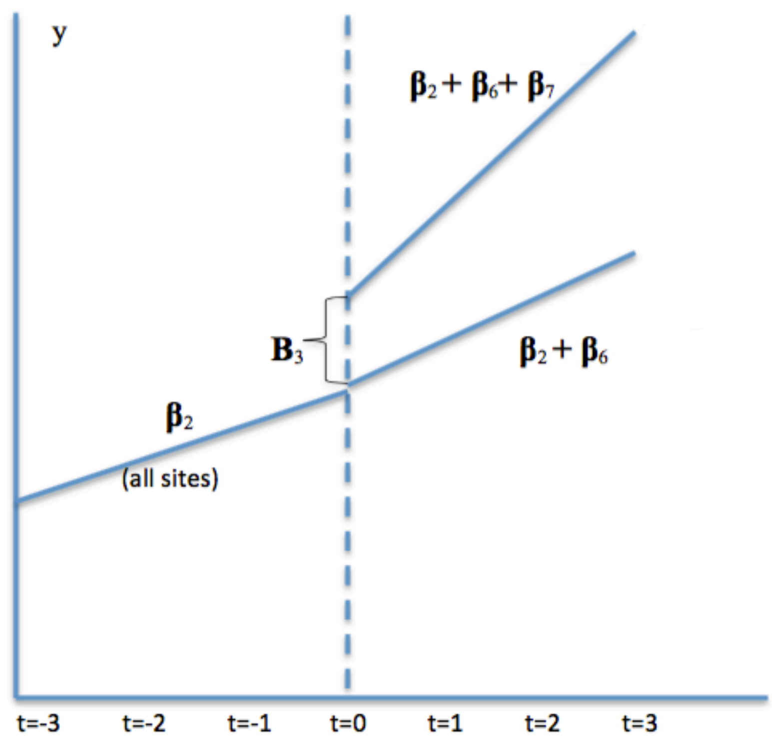
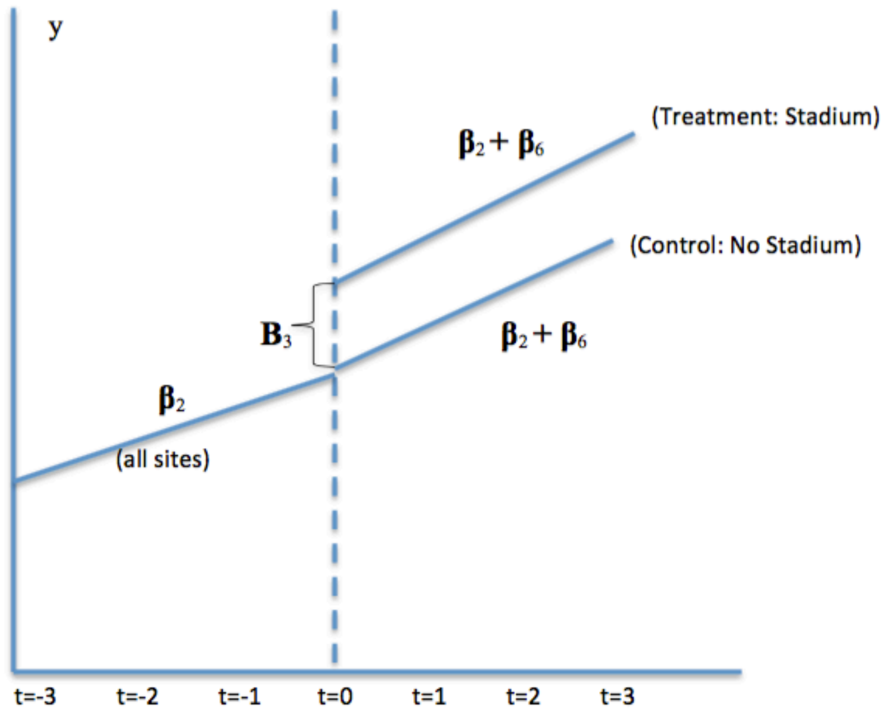
Appendix

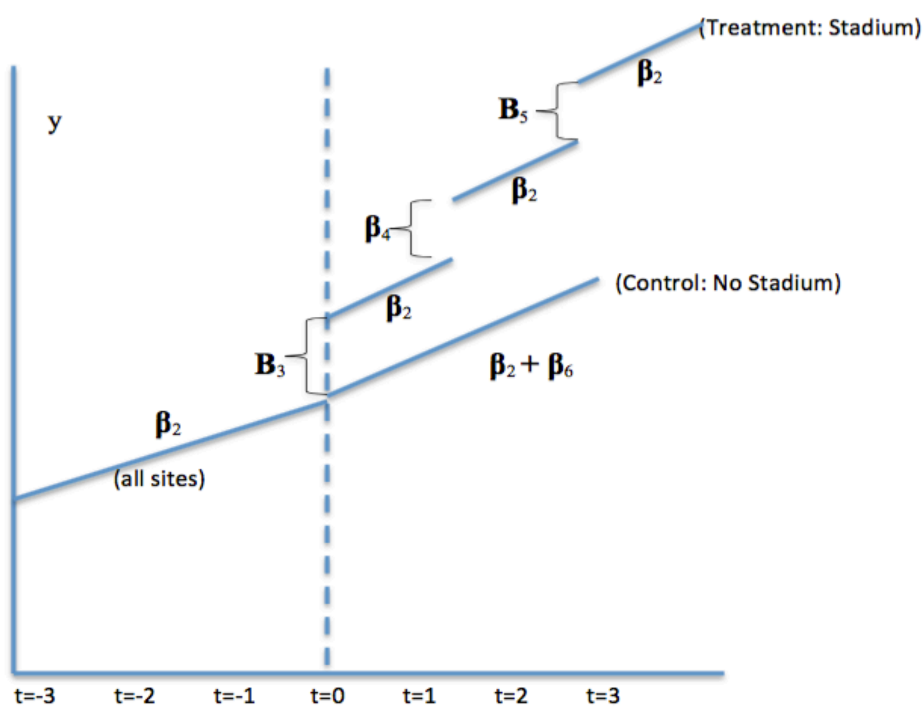
Graph 1: Visualization of Equation (1)



Graph 2: Visualization of Equation (2)



Graph 3: Visualization of Equation (3)



Tables 1-5: Summary Statistics

Table 1: Employment Growth in Stadium Sites

Employment Growth					
Year	**Mean**	**Variance**	**Standard Deviation**	**Min**	**Max**
-3	0.045	0.022	0.149	-0.143	0.662
-2	0.017	0.004	0.064	-0.066	0.154
-1	0.032	0.012	0.111	-0.244	0.332
0	0.014	0.012	0.111	-0.164	0.33
1	0.024	0.044	0.21	-0.358	0.938
2	0.036	0.048	0.219	-0.271	0.905
3	-0.006	0.014	0.116	-0.471	0.14

Employment Growth					
Year	**Mean**	**Variance**	**Standard Deviation**	**Min**	**Max**
-3	-0.007	0.009	0.093	-0.232	0.15
-2	0.024	0.007	0.081	-0.125	0.258
-1	0.018	0.007	0.085	-0.161	0.183
0	0.019	0.004	0.067	-0.091	0.206
1	0.011	0.012	0.109	-0.222	0.217
2	-0.016	0.005	0.067	-0.155	0.084
3	-0.003	0.006	0.076	-0.137	0.118

Table 3: Eating and Drinking Establishments as Proportion of Total Establishment in Stadium Sites

Proportion of Eating and Drinking Places to Total Businesses in ZIP Code					
Year	**Mean**	**Variance**	**Standard Deviation**	**Min**	**Max**
-3	0.026	0	0.008	0.012	0.043
-2	0.027	0	0.009	0.013	0.045
-1	0.027	0	0.009	0.014	0.045
0	0.028	0	0.008	0.017	0.043
1	0.029	0	0.01	0.01	0.045
2	0.03	0	0.01	0.017	0.054
3	0.032	0	0.01	0.017	0.057

Table 4: Eating and Drinking Establishments as Proportion of Total Establishment in Alternative Locations

Proportion of Eating and Drinking Places to Total Businesses in ZIP Code					
Year	**Mean**	**Variance**	**Standard Deviation**	**Min**	**Max**
-3	0.027	0	0.011	0.006	0.052
-2	0.027	0	0.011	0.008	0.051
-1	0.028	0	0.011	0.006	0.049
0	0.028	0	0.013	0.005	0.052
1	0.029	0	0.011	0.01	0.052
2	0.031	0	0.012	0.011	0.053
3	0.031	0	0.012	0.012	0.053

Table 5: Stadium Count By Year

Year	Stadiums
1996	1
1997	0
1998	2
1999	1
2000	6
2001	1
2002	3
2003	0
2004	1
2005	0
2006	1
2007	0
2008	2
2009	3
2010	1
2011	0
2012	1
2013	0
2014	3

Table 6: Observations By League

Minor League Baseball	13
MLB	7
NFL	7

Table 7: Alternative Location Statistics

Number of Stadiums With Alt:	20
Min Alts/Stadium:	0
Max Alts/Stadium	5
Avg Alts/Stadium	1.185
Std. Dev Alts/Stadium	1.156

Table 12: Employment Growth Estimation - Treatment Group Restricted to NFL and MLB Stadiums, Control Group Consisting of City and AAA Baseball Stadiums

	Change in Employment		
	Model A	Model B	Model C
Trend	-.00056 (.01173)	-.00248 (.01139)	-.00751** (.00352)
Post*Stadium	.10357 (.09346)	.04033* (.02076)	
Post*Trend	-.00448 (.00822)	-.00349 (.00809)	
Post*Trend*Stadium	-.01162 (.01674)		
Year0*Stadium			.0084 (.03621)
Year1*Stadium			.08487 (.03643)
Year2*Stadium			.0947** (.03697)
n	294	294	294
Adjusted R-Squared	0.00777	0.00954	0.03102

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

Table 13: Employment Growth Estimation For MLB and NFL Stadiums, Outliers Removed

	Change in Employment *(Target Field year t+2 and Petco Park year t+1 removed)*		
	Model A	Model B	Model C
Trend	-.00056 (.00914)	-.00244 (.00888)	-.00751*** (.00278)
Post*Stadium	.06078 (.07317)	-.00164 (.01647(	
Post*Trend	-.00448 (.00641)	-.00351 (.00631)	
Post*Trend*Stadium	.06078 (.07317)		
Year0*Stadium			.0084 (.02859)
Year1*Stadium			-.0001 (.03009)
Year2*Stadium			.01328 (.03051)
n	292	292	292
Adjusted R-Squared	0.0147	0.01549	0.0118

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

Table 14: Proportion of Eating and Drinking Establishments - Treatment Group Restricted to NFL and MLB Stadiums, Control Group Consisting of City and AAA Baseball Stadiums

	Proportion of Eating and Drinking Establishments to Total Establishments		
	Model A	Model B	Model C
Trend	.00044 (.00072)	.00063 (.0007)	.0006*** (.00022)
Post*Stadium	.00202 (.00576)	.0039*** (.00128)	
Post*Trend	-0.000001 (.00051)	-.0001 (.0005)	
Post*Trend*Stadium	.00114 (.00103)		
Year0*Stadium			.00184 (.00228)
Year1*Stadium			.0031 (.00229)
Year2*Stadium			.00407* (.00233)
n	294	294	294
Adjusted R-Squared	0.05656	0.0558	0.03894

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

Table 15: Employment Growth Estimation - Treatment Group Restricted to NFL and MLB Stadiums, Control Group Consisting of Alternate Locations and AAA Baseball Stadiums

	Change in Employment		
	Model A	Model B	Model C
Trend	-.00193 (.01179)	-.00089 (.0118)	-.00399 (.01614)
Post*Stadium	.00366 (.02122)	.01804 (.01902)	
Post*Trend	-.00351 (.00869)	-.00398 (.00871)	
Post*Trend*Stadium	.00647 (.00427)		
Year0*Stadium			.00399 (.03782)
Year1*Stadium			-.00862 (.04185)
Year2*Stadium			-.01291 (.04236)
n	294	294	294
Adjusted R-Squared	0.00142	-0.00303	-0.0092

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%

Table 16: Proportion of Eating and Drinking Establishments - Treatment Group Restricted to NFL and MLB Stadiums, Control Group Consisting of Alternates and AAA Baseball Stadiums

	Proportion of Eating and Drinking Establishments to Total Establishments		
	Model A	Model B	Model C
Trend	.0006 (.00094)	.00073 (.00091)	.00084*** (.00029)
Post*Stadium	-.00414 (.00774)	.00041 (.00171)	
Post*Trend	0.00014 (.00066)	.00008 (.00065)	
Post*Trend*Stadium	.00083 (.00139)		
Year0*Stadium			-.00088 (.00304)
Year1*Stadium			.00015 (.00306)
Year2*Stadium			.00088 (.0031)
n	315	315	315
Adjusted R-Squared	0.0184	0.02042	0.01755

Clustered standard errors are in parentheses; * is significant at 10% level, ** at 5%, *** at 1%