The Impact of Replacement Stadiums on Property Values: A CPUMA Geographic Level Approach

Conference Paper – Preliminary Results – Not for Distribution

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Abstract

Billions of dollars are spent annually constructing new facilities for professional sport teams. In recent years, a good portion of that spending is for facilities that replace existing facilities in the same city. This paper examines the role of new sporting facilities as local amenities that contribute to the value of housing prices. It investigates facilities opened between 2005 and 2017 in the top five professional leagues in the United States by utilizing a Consistent Public Use Microdata Area (CPUMA) to capture the local effect of a team and adjacent effects in bordering CPUMAs. It finds no significant effects of construction years or opening years on housing values in either the main or surrounding CPUMAs. The league for which the facility was built can be significantly positive or negative, with the effect changing depending on the specification.

Keywords: Stadium subsidies, local growth, property values

JEL Classification: Z28, H71

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1. Introduction

Constructing major league sports stadiums and arenas in the U.S. is big business. Over $14.5 billion (in 2016$) was spent between 2010 and 2018 with the public covering 46% of that cost, on average (Zimbalist & Agha, 2019). Proponents of such subsidies argue that stadiums boost local economic growth, improve wages and employment, and generate net positive revenue for local and governments in the long-run. However, the economics literature suggests otherwise (e.g. Coates & Humphreys, 2008). To further explain why public subsidies persist, the economic literature has investigated the extent to which the intangible benefits of a sports facility are capitalized into rents or housing values and finds positive effects in small spatial proximity to facilities (e.g. Feng & Humphreys, 2012).

Of recent concern is that the majority of stadium and arena construction in North America now consists of replacement facilities for teams in the same market. For example, in Arlington, TX the MLB Texas Rangers have played in Arlington Stadium since 1994. In 2016, just 22 years after opening, voters extended a sales and hotel tax to provide up to $500 million towards the construction of a new $1.2 billion stadium across the street from the existing facility. If claims of wage, income, and tax growth are true (disregarding academic evidence to the contrary) then it is likely these benefits already accrued to a local economy in the presence of the first facility. Yet, in the search for public funds for replacement facilities, the same claims of positive benefits are often made. In applying the same logic to the effect of intangible benefits on housing values, it would seem a replacement facility would also afford no additional benefit beyond the original.

This paper evaluates the claims of proponents of facility subsidies through a hedonic pricing model that assesses the impact of stadiums and arenas on home values in the top five major professional sports leagues (NFL, NBA, MLB, NHL, MLS) constructed between 2005 and 2017. This paper offers several new contributions. First, we distinguish between replacement facilities and the construction of a new facility in a market that does not yet have one. Next, the analysis uses Consistent Public Use Microdata Area (CPUMA) geographic level data, a mid-sized geographical unit, which allows for analysis of all cities as opposed to single-city case studies that primarily use single housing unit observations. CPUMAs provide more precision than MSAs and allow for a panel data set that spans the U.S. over a period of 13 years. Furthermore, this use of panel data allows for the ability to capture the effect during construction, and the effect during the facility's opening year. The cost of each facility and the fraction of cost that is publicly financed is also included.

We find virtually no evidence that the construction or opening of a replacement facility for any of the five major professional league in the US has any significant effects, positive or negative, on main or surrounding CPUMAs. We find evidence that the league for which the facility was built can be significantly positive or negative, with the effect changing depending on the specification.

2. Related Literature

Ex post economic impact is typically measured through changes in income, sales tax, or jobs. Coates and Humphreys (2008) reviewed existing literature and concluded that there was "no substantial evidence of increased jobs, incomes, or tax revenues for a community associated with [stadiums]" (p. 310) More recent attempts to understand the role of new stadiums in communities have taken an economic development perspective and focused on the propensity of positive externalities to manifest as changes in housing values. These take the form of single city case studies or larger cross-sectional studies across the U.S.

The first case study on sport facilities examined the effects of the construction of FedEx Field, home of the Washington Redskins, on housing prices. Using a difference in difference approach with a hedonic pricing model, Tu (2005) found that property values of single family homes within a three mile radius increased, though the effects depended on geographical proximity with those closest experiencing the highest shift. Tu, like this paper, broke down the effect into three phases. In the pre-construction phase, he found that properties closer to the proposed stadium site had lower value relative to properties located further away from the proposed site. However, this difference became less pronounced after construction.

Dehring, Depken, and Ward (2007) examined how the announcement of a new stadium in the Dallas-Fort-Worth Area affected property values. They found that residential property values in the city of Dallas increased following the announcement of a possible new stadium in the city. At the same time, property values fell throughout the rest of Dallas County, which would have paid for the proposed stadium. Once the project was abandoned and announcements were made to move the project to Arlington, property values in the city of Arlington went down. The authors concluded that proximity has an overall ambiguous effect on residential property values which is different from Tu's results. Ahlfeldt and Kavetsos (2011) also looked at stadium announcements but in the context of football in London. The 1.7% increase in property values for every 10% decrease in distance was nearly double that found by Feng and Humphreys (2008). Despite positive effects near a new facility (Emirates Stadium) the net effect was zero due to negative effects near the old stadium (Highbury Road). This relates closely to our premise that replacement stadiums will be unlikely to generate any additional net benefits to a community.

Two additional studies focused on single cities. Using a spatial hedonic approach in Columbus, OH, Feng and Humphreys (2008) found housing values increased as the distance to two sports facilities decreased. Finally, Ahlfeldt and Maennig (2010) investigated the effect of new facilities on land values in Berlin and found positive effects within 3km, though, similar to Tu (2005), the effect was strongest near the facility and dissipated with distance.

For the most part, these case studies tell a consistent story in terms of a positive distance decaying effect around major league sport facilities even though it is difficult to more broadly generalize the effects to all cities. Only three studies have taken a more generalizable cross-sectional approach using MSA-level data. Carlino and Coulson (2004) examined 53 of the largest MSAs from 1993 and 1999 to assess the effect of NFL franchises on rents. They found a statistically significant approximately eight percent increase in property rents using a hedonic pricing model. The effect only existed for central city samples and not throughout the MSA indicating the importance of proximity to the stadium. Kiel, Matheson, and Sullivan (2010) extended this hedonic approach to analyze housing values instead of rents and concluded that the "presence of an NFL franchise has no effect on housing prices in a city." They also looked at the amount of the subsidy (an approach taken in this paper) and find it has a significant negative effect on home values.

With clear evidence that sport related effects are spatially limited, Feng and Humphreys (2012) analyzed a cross-sectional sample using census block groups within five miles of stadiums and found higher median housing values closer to facilities. This research was important because it was the first to extend hedonic analysis to the four largest sports leagues in the U.S. (MLB, NBA, NFL, and NHL). To do so required moving beyond individual housing unit observations to census blocks. One drawback of this intermediate size (between MSAs and individual housing units) was that only census years could be used (1990 and 2000). We solve this by using annual CPUMA level data that allows for the creation of a 13 year panel.

In looking for an effect of professional sports, it can come from the team itself or from the facility in which it plays. Carlino and Coulson (2004) and Kiel et al. (2010) focused on teams while the other studies focused on facilities. None of the cross-sectional research on housing values differentiate between new stadiums or replacement facilities. This paper aims to fill this literature gap by analyzing replacement facilities at the CPUMA geographic level. By focusing on replacement stadiums, any effect we identify will be for the stadium itself and not from externalities of the team.

3. Model and Variables

The hedonic approach necessitates controlling for characteristics of the housing unit, the geographic unit (city or neighborhood), and the sports facilities in the CPUMA. We estimate the form of the hedonic model as

$$Y = \alpha + X\beta + \varepsilon$$

where Y is a vector of the log of housing values, X is a matrix of housing-related, CPUMA-related, and sporting variables, and α and β are vectors of parameters to be estimated. The random disturbance term ε has expected mean zero, variance that differs by CPUMA, and serial correlation by CPUMA. Diagnostic testing indicates there are multiple deviations from the classical regression model assumptions. Pesaran's (2004) cross-sectional dependence test $\chi^2(136) = 38.035$, $p < .0001$ confirms error terms are not independent across cross sections in the same year. A likelihood ratio (LR) test, $\chi^2(136) = 1041.02$, $p < .0001$, rejects the null hypothesis of homoskedasticity suggesting each CPUMA has its own error variance and Im, Pesaran, and Shin's panel unit root test (2003) fails to reject the null of unit root series ($p = .876$). Due to cross sectional heteroskedasticity, within panel serial correlation, and correlated errors across panels, we estimate both log-linear and log-log forms using a GLS estimation that corrects for these violations of the required functional form.

The variables for this paper come from the American Community Survey (ACS), an ongoing household survey conducted by the U.S. Census Bureau. The survey is administered to about 3.5 million housing units and has a 95% response rate. A major drawback with using PUMAs is that their boundaries changed after the 2010 census because each PUMA is required to have at least 100,000 people. The shifts mostly affected rural and suburban regions that did not have stadiums, but the result was a split sample with one set of consistent boundaries and geographic identifiers from 2005 to 2011 and then a different set of consistent boundaries from 2012 to 2017.

To fix this problem and to harmonize PUMAs across the two censuses, we utilize IPUMS-USA's custom dataset generator to produce a household level dataset at a Consistent Public Use Microdata Area (CPUMA) geographical level. The CPUMA is an aggregation of one or more 2010 PUMAs that align within a 1% population error tolerance with a corresponding set of 2000 PUMAs.[1] This is effectively the smallest geographic unit that can be identified consistently from 2000 and later, at least until the 2020 Census takes place. We then aggregate the household level dataset up to a CPUMA level by using weights provided by IPUMS-USA to construct a panel dataset for all CPUMAs from 2005-2017. The dataset contains 14,014 CPUMA-year observations though we analyze a sub-sample of 1,781 CPUMA-year observations

[1] "0010 CONSPUMA Definitions," IPUMS USA, March 6, 2019, https://usa.ipums.org/usa/volii/cpuma0010.shtml

that encompass all 13 years of the 137 CPUMAs that included or were directly adjacent to a newly constructed facility.

A single CPUMA unit is a much smaller unit of area than a single MSA and can be used to capture spatial effects of new facilities. However, since CPUMA size varies quite a bit from region to region, they are not a perfect measure for proximity. To account for this, we define main CPUMAs as those in which the facility was constructed and surrounding CPUMAs as those that are geographically adjacent to the main CPUMA. Surrounding CPUMAs were identified by geolocating stadia using an interactive web map with CPUMA boundaries on the IPUMS website.[2]

First, we identified the main CPUMA for each stadia by simply searching the address of each stadium using the map. Second, we manually identified all surrounding CPUMAs which are defined as CPUMAs that share a boundary with the main CPUMAs.

Since the unit of observation is a CPUMA in a particular year and the dummies and interaction terms are stadium characteristics, problems arise when more than one stadium is built in a single region or if a main CPUMA is also a surrounding CPUMA for another stadium during the *same* years. In these situations, we prioritize stadiums with higher costs to be able to find the maximum possible effect, should one exist. And if a surrounding CPUMA gets its own stadium, then the stadium constructed inside the main CPUMA gets priority over the surrounding effect. For example, Avaya Stadium's surrounding CPUMAs (139 140 144) are also surrounding CPUMAs for Levi's Stadium and both stadiums have the same construction/opening years. This happens with SunTrust Park and Mercedes Benz Stadium as well. The dataset contains 28 stadiums but there are only 26 unique main CPUMAs because two stadiums are built in some

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[2] "CPUMA 0010 Boundary. 2010" IPUMS USA, March 6, 2019, https://usa.ipums.org/usa/volii/CPUMA0010v10.shtml

CPUMAs. Both Target Field and US Bank Stadium are located in CPUMA number 527, which is part of downtown Minneapolis, and both the Amway Center and the Orlando City Stadium are located in CPUMA number 239 which corresponds to downtown Orlando. These situations arise in a few other instances when we are required to prioritize certain CPUMAs over others.

The dependent variable is the natural log of the mean property value of a housing unit in each CPUMA. Independent variables designed to estimate the value of a home can be categorized as those related to housing units, the geographic CPUMA unit, and the sporting environment (see descriptive stats in Table 1).

Housing-related characteristics include the mean number of rooms, bedrooms, vehicles, and mean year the housing unit was built. It also includes the mean percentage of units that are detached and the mean percentage of households that are rented. CPUMA-level characteristics include the percent Hispanic, percent black, percent that hold a bachelors degree, the percent employed, population, and median household income. Though other housing-unit and geographic-unit variables are used in hedonic research, we were limited to the variables that were gathered by the ACS every year between 2005 and 2017.

Sporting variables include all stadiums in the top five leagues—NFL, NBA, MLB, NHL and MLS—constructed between 2005-17 (see Table 2). There were 28 stadiums opened in this time period and this data was collected using a variety of sources, including previous literature and community sourced websites like Statista and Wikipedia.

We track the construction and opening of a stadium both for the main CPUMA and the surrounding CPUMAs using four independent dummy variables. The construction dummy is turned on when construction begins and is turned off during the opening and subsequent years. Construction is coded for both the main and surrounding CPUMAs. The opening year dummy is only on for the year that the stadium opens and is similarly coded for both main and surrounding CPUMAs. In order to separate the effect of a replacement stadium for an existing team from the effect of a new stadium for a new team, we add two dummies to track replacement stadiums. The first (replacement) measures if the stadium is replacing another stadium for the same team. The second dummy more specifically tracks if the replacement stadium was built in the same CPUMA as the former stadium. This allows for more specific testing of the effect of a replacement stadium.

The dataset also contains other independent variables such as dummy variables that indicate the primary tenant's professional league for each new facility during the construction and opening years, total construction costs in 2017 dollars, and the percentage of cost that is publicly subsidized. There are two different ways we can code the cost of a particular facility in this set-up where a row is a geographic unit in a particular year. The cost can be spread over the construction years by dividing the total cost by number of construction years or the total cost of the stadia can be coded in the opening year. We choose the former approach with the logic that if a construction effect exists, it would likely be a function of the annual expenditures on construction, not by applying the full cost of construction to the opening year.

4. Results

We begin with a log-linear model that measures the effect of stadia on property values through use of the replacement and replacement-in-same-CPUMA variables. Model 1 specifies a replacement facility in the same CPUMA and Model 2 interacts that replacement facility with construction cost. Of note, there is no significance of constructing or opening a new facility in any of the models. The replacement variable is insignificant in Model 1 and is significantly negative in Model 2 when an interaction term is added with the cost of construction. The interaction term also shifts the significance from the NBA to MLS for models with replacement facilities in the same CPUMA while MLB remains significant in both models.

Using the same functional form as Models 1 and 2, log-log models were also estimated as Model 3 and Model 4 (see Table 4). Unlike the log-linear models, in Model 3 there is significance on the construction years in surrounding CPUMAs, the MLS coefficient is statistically negative, the NHL coefficients are statistically positive, and the positive values for MLB in Models 1 and 2 have shifted to insignificant. Similar to before, the addition of an interaction term in Model 4 changes the significance of the sporting variables, with MLS and NHL losing significance and MLB becoming significantly negative.

The most notable feature of Models 1-4 is the instability of the significance on the sporting variables given small changes in the regression models. Further sensitivity testing involved removing population and removing household income (not reported here). All resulted in similar instability of the league variables.

Instead of interacting replacement and stadium cost, an additional attempt interacted the replacement variable with each of the league variables (see Model 5 in Table 5). In this model, none of the league variables are significant and the log of construction cost is negative and significant.

Because the league variables are coded for the years that a stadium was under construction and open, they are in some ways ‘double counting’ the construction and opening effects that are already accounted for. The log-log Model 6 and 7 in Table 5 replicate Models 3 and 4 but remove the league effects completely. They indicate a significant positive effect on surrounding CPUMAs during construction, but a significant negative effect of the cost of construction that could eliminate the construction effect given the average cost of most facilities. Finally, Models 8 and 9 take a different approach to measuring the existence of a replacement stadium. First, two variables are created to capture a replacement stadium in the same CPUMA versus a non-replacement stadium (defined as a replacement stadium elsewhere in the region but not in the same CPUMA). These are then interacted for construction and opening years in the main CPUMA and for construction and opening years in the surrounding CPUMA. The result is eight variables that simultaneously capture replacement status, geographic proximity to the new stadium (main or surrounding), and the construction status (under construction or opening year). All of the eight variables are insignificant with only a small significant effect for NBA teams.

5. Discussion and Conclusion

This paper makes three key contributions to the literature on the relationship between the construction of new sports facilities and property values—the distinction between replacement and non-replacement stadiums, the introduction of the CPUMA geographic level, and capturing the effect of stadiums during the construction and opening stages.

As a whole we find virtually no evidence that the construction or opening of a replacement facility for any of the five major professional league in the US has any significant effects, positive or negative, on main or surrounding CPUMAs. We find evidence that the league for which the facility was built can be significantly positive or negative, with the effect changing depending on the specification. The NBA is the only league that retained the same sign (positive) in the specifications for which it was significant. The main CPUMA versus surrounding CPUMA dichotomy does not allow for the quantification of any distance decaying effect, but is generalizable across the US.

The findings in this paper should be considered preliminary. We are still investigating the practicality of aggregating weighted individual observations into CPUMAs versus analyzing individual observations. The limiting factor is solely computing power and the ability of software to analyze enough observations. In addition, the trade off in accuracy by using PUMAs as a proxy for distance didn’t work out as nicely as expected. To create a consistent panel from 2005 to 2017 we were forced to use larger CPUMAs instead of smaller PUMA areas. This resulted in an unexpectedly large amount of variation in the size and population among CPUMAs. Even when comparing large markets, for example, New York CPUMAs are far from similar to Los Angeles CPUMAs.

With the majority of sporting facilities constructed in the same city as a replacement for an existing facility, it is important to evaluate the difference between these compared to facilities that are new to a city.

References

Ahlfeldt, G. M., & Kavetsos, G. (2011). Form or function? The impact of new football stadia on property prices in London, SERC Discussion Papers, Spatial Economics Research Centre, LSE. http://EconPapers.repec.org/RePEc:cep:sercdp:0087.

Ahlfeldt, G. M. & Maennig, W. (2010). Impact of sports arenas on land values: Evidence from Berlin. *The Annals of Regional Science, 44*(2), 205-227.

Carlino, G. A., & Coulson, N. E. (2004). Compensating differentials and the social benefits of the NFL. *Journal of Urban Economics, 56*(1), 25–50.

Coates, D. & Humphreys, B. R. (2008). Do economists reach a conclusion on subsidies for sports franchises, stadiums, and mega-events? *Economic Journal Watch, 5*(3), 294-315.

Coates, Dennis & Humphreys, Brad R. & Zimbalist, Andrew, 2006. "Compensating differentials and the social benefits of the NFL: A comment," Journal of Urban Economics, Elsevier, vol. 60(1), pages 124-131, July.

Dehring, C. A., Depken, C. A., & Ward, M. R. (2007). The impact of stadium announcements on residential property values: Evidence from a natural experiment in Dallas-Fort Worth. *Contemporary Economic Policy, 25*(4), 627–638.

Feng, Xia and Humphreys, Brad, (2008), Assessing the Economic Impact of Sports Facilities on Residential Property Values: A Spatial Hedonic Approach, No 0812, Working Papers, International Association of Sports Economists

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115*, 53-74.

Kiel, K. A., Matheson, V., & Sullivan, C. (2010). ‘‘The Effect of Sports Franchises on Property Values: The Role of Owners versus Renters,” Working Papers 1007, International Association of Sports Economists & North American Association of Sports Economists.

Pesaran, M. H. (2004). *General diagnostic tests for cross section dependence in panels*. University of Cambridge, Cambridge Working Papers in Economics (No. 0435, pp. 1–40).

Ruggles, S., Flood, S., Goeken, R., Grover, J., Meyer, E., Pacas, J., & Sobek, M. *IPUMS USA: Version 8.0* [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0

Tu, C. C. (2005). How does a new sports stadium affect housing values? The case of FedEx field. Land Economics, 81(3), 379–395.

Tu, C. C. (2005). How does a new sports stadium affect housing values? The case of FedEx Field. *Land Economics, 81*(3), 379–395.

Zimbalist, A. & Agha, N. (2019). Economic impacts of sport facilities. In Joseph A. Maguire (Ed.) *The Business and Culture of Sports*, Cengage.

Table 1. Descriptive Statistics, n=1,781

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
lnvaluehome	12.637	0.567	11.445	14.700
hispanic	0.203	0.174	0.001	0.740
black	0.189	0.193	0.000	0.975
bachelors	0.139	0.056	0.028	0.340
detached	0.497	0.243	0.002	0.854
rooms	5.499	0.815	3.459	8.033
built_year	1972	13	1943	1996
bedrooms	2.608	0.428	1.379	4.029
vehicles	1.807	0.296	1.105	2.608
vacant	0.045	0.025	0.001	0.208
employed	0.470	0.054	0.301	0.666
population	485,300	640,455	83,536	4,658,832
household income	61,756	18,964	21,660	161,874
construct years (main)	0.036	0.186	0	1
open year (main)	0.017	0.129	0	1
construct years (surrounding)	0.157	0.364	0	1
open year (surrounding)	0.069	0.254	0	1
cost of construction	53.347	142.622	0	896.756
replacement facility	0.204	0.403	0	1
replacement in same CPUMA	0.165	0.371	0	1
NFL	0.182	0.386	0	1
MLB	0.103	0.304	0	1
NBA	0.185	0.389	0	1
MLS	0.164	0.370	0	1
NHL	0.035	0.183	0	1

Table 2. Summary of Sports Facility Spending, by League, in the Sample

League	Average Cost (millions, $2014)	Average Public Fraction (%)
NFL	1186.0	36.3
NBA	484.4	28.0
MLB	979.7	35.5
NHL	402.4	28.0
MLS	220.5	42.0

Table 3. Log-linear estimation of the ln of the value of a home

	Model 1	Model 2
hispanic	0.429	-0.356
black	-0.080	-0.527*
bachelors	0.549	-0.496
detached	-0.732*	-1.353***
rooms	-0.045	-0.105
built_year	0.005	-0.004
bedrooms	0.017	-0.056
vehicles	-0.051	0.041
vacant	-0.772	-0.547
employed	-0.265	-0.959
population	0.000	0.000
household income	0.00002***	0.00001***
construct years (main)	0.102	0.199
open year (main)	-0.036	-0.031
construct years (surrounding)	0.048	0.036
open year (surrounding)	0.022	-0.044
construction cost	-0.0001	-0.0002
replacement-same CPUMA	-0.093	-0.152*
NFL	0.054	0.242
MLB	0.235***	0.335***
NBA	0.218***	0.092
MLS	-0.022	0.195*
NHL	(omitted)	(omitted)
replacement-same * construction cost		0.0002
constant	3.509	20.724*
Wald Chi-Square	998.45	1366.150

* p<0.05; ** p<0.01; *** p<0.001

Table 4. Log-log estimation of the ln of the value of a home

	Model 3	Model 4
lnhispanic	0.094***	0.102*
lnblack	-0.061	-0.047
lnbachelors	0.094	0.156**
lndetached	-0.031	-0.021
lnrooms	-0.154	-0.141
lnbuilt_year	-26.014***	-30.925***
lnbedrooms	-0.294	-0.012
lnvehicles	-0.315*	-0.209
lnvacant	0.012	-0.049*
lnemployed	0.018	0.112
lnpopulation	0.007	-0.210*
lnhousehold income	0.544***	0.630***
construct years (main)	0.024	0.041
open year (main)	0.025	-0.019
construct years (surrounding)	0.238*	0.071
open year (surrounding)	0.017	-0.018
ln construction cost	-0.034	-0.010
replacement-same CPUMA	-0.005	0.089
NFL	0.000	0.000
MLB	0.042	-0.165*
NBA	0.261***	0.202***
MLS	-0.308*	-0.210
NHL	0.233**	0.167
replacement-same*lnconstruction cost		-0.011
replacement-same*NFL		
replacement-same*MLB		
replacement-same*NBA		
replacement-same*MLS		
replacement-same*NHL		
constant	204.755***	243.530**
Wald Chi-Square	887.290	192.430

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

Table 5. Sensitivity tests

	Model 5	Model 6	Model 7	Model 8	Model 9
lnhispanic	0.131***	0.131***	0.139***	0.096***	0.132***
lnblack	-0.083**	-0.084**	-0.065	-0.057	-0.036
lnbachelors	0.138*	0.137*	0.161*	0.097	0.141*
lndetached	-0.063*	-.060*	-.069*	-0.030	0.024
lnrooms	-0.392	-0.370	-0.051	-0.096	0.645
lnbuilt_year	-25.410**	-25.841**	-20.659***	-28.259***	-20.585*
lnbedrooms	0.041	0.036	-0.022	-0.338	-1.007*
lnvehicles	-0.053	-0.062	-0.186	-0.265	-0.150
lnvacant	-0.038	-0.037	-0.028	0.014	-0.030
lnemployed	0.048	0.038	-0.050	-0.013	0.197
lnpopulation	-0.050	-0.054	-0.071	0.002	-0.269*
lnhousehold income	0.702***	0.702***	0.672***	0.523***	.0499***
construct years (main)	0.326	0.337	0.117		
open year (main)	-0.114	-0.117	-0.044		
construct years (surrounding)	0.121	0.126	0.093		
open year (surrounding)	-0.010	-0.009	0.011		
ln construction cost	-0.029*	-0.029*	-0.019	-0.031	-0.021
replacement-same CPUMA		0.067	0.035		
NFL				(omitted)	0.048
MLB				0.037	(omitted)
NBA				0.256***	0.018**
MLS				-0.333**	0.025
NHL				0.023*	0.096
replacement-same*lnconstruction cost			0.006		-0.002
replacement-same*NFL	(omitted)				
replacement-same*MLB	0.070				
replacement-same*NBA	0.079				
replacement-same*MLS	(omitted)				
replacement-same*NHL	(omitted)				
replacement-same*construct years (main)				(omitted)	(omitted)
non-replacement-same*construct years (main)				-0.001	0.224
replacement-same*open year (main)				(omitted)	(omitted)
non-replacement-same*open year (main)				0.004	0.111
replacement-same*construct years (surrounding)				0.210	0.064
non-replacement-same*construct years (surrounding)				0.235*	0.077
replacement-same*open year (surrounding)				0.026	-0.096
non-replacement-same*open year (surrounding)				0.018	-0.043
constant	199.189**	202.482**	163.322***	221.989***	167.112**
Wald Chi-Square	423.240	418.69	419.18	947.470	233.920

* p<0.05; ** p<0.01; *** p<0.001