The Impact of Promotion to the Premier League on the Price of Residential Property
An Analysis of Transactions in England

ABSTRACT. Presence of a football stadium is believed to bring consumption amenities that translate in a higher willingness to pay for residential property. As it is assumed that a high performing team also generates higher utility for those living nearby, a team that promotes to a higher league should also generate increased prices paid for housing. This hypothesis is tested in the context of England, where the Premier League operates as the highest and most popular league. Regions profit from team promotion because of increased tourism and broadcast television income, but the effect on residential property has not yet been investigated. This study fills this research gap by implementing a repeat sales analysis in the areas around teams that promoted in the period 2012-2015, using data from HM Land Registry. Results show positive external effects of promotion in a control area of 5 kilometres. A property that is sold before and after promotion located directly next to the stadium experiences an additional price increase of at least 2,84%. These results are robust in terms of sign when using different specifications.
Keywords: Premier League football, civic pride, utility maximalization, repeat sales analysis

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1. INTRODUCTION

1.1 Motivation

Since the start of the 21st century, the importance of provision of consumption of amenities in cities has increasingly become recognized as a major contributor of a city's success. It is argued that cities with high amenity levels attract populations and tourists that subsequently increase the demand for residential housing (Glaeser et al., 2001). Some amenities require large nearby markets to support them, and sports stadiums can be regarded as one of the largest and most popular amenities in this context. Stadiums offer entertainment that is of high cultural significance in almost any country: professional sports. Furthermore, due to their ability to attract large amounts of crowds, their nearby vicinity has become attractive to a wide array of other amenities, such as restaurants, shops and other leisure activities. Despite potential negative side effects, recent research has shown that stadiums have a positive effect of nearby house prices (e.g. Ahlfeldt & Meannig, 2010; Ahlfeldt & Kavetsos, 2014). However, whether the performance of the stadium's tenant has any additional effect on nearby house prices, has remained largely unclear. This can be regarded as surprising, since teams vary greatly in terms of size and exposure, and can therefore be expected to bring varying consumption benefits. This is also evident in the context of England and Wales, where the Premier League (PL) acts as the highest level of professional football. Promoting to this league brings in significant financial benefits. Furthermore, teams in the PL attract almost twice the number of spectators compared to the second level Championship (34.000 and 18.000, respectively) (Bleacher Report, 2012). This is in part because some teams in the PL have large venues hosting up to 80.0000 seats, meanwhile promoting teams may also experience increases up to 27% in terms of spectators. The aim of this study is to go beyond the effect of a stadium or its construction on house prices and examine the relationship between the performance of a team and the willingness to pay for residential housing.

1.2 Societal and scientific relevance

The PL is one of the biggest leagues in the world in terms of revenue, only behind the US Major League Baseball and Nationals Football League. In 2013/2014, the PL and its clubs contributed to over 100.000 jobs in the UK and added 3,4 billion GBP to the GDP (Ernst and Young LLP, 2015). Case studies in Liverpool (Johnstone et al., 2000), Glasgow (Allen et al., 2017) and Swansea (Roberts et al., 2016) have shown that British teams also have a significant impact on the local economy. Teams increase local employment, both directly and indirectly. This increase is partly due to an increase in tourism, which implies that economic spending also comes from outside the region. Moreover, promotion to PL also means additional television income gained by the region, which is estimated to be 50 million GBP per region in 2016. As a result, local policymakers have taken interest in sports as an instrument for economic development and often municipalities subsidize construction of stadiums in order to keep them in the vicinity (Groothuis, Johnson and Whitehead, 2004; Johnstone et al., 2000).

Along with impact on the economy, PL teams may have another indirect economic impact: a change in nearby house prices. While there are a number of reasons to believe these impacts may be negative (e.g. noise and congestion), literature has shown this effect to be largely positive. Ahlfeldt and Kavetsos (2013) mention increased consumption benefits, extended spending due to investments and improved neighbourhood prestige as factors that positively influence nearby property prices. The latter point is particularly interesting, since it assumes implies that civic pride being capitalized in property prices by utility maximizing consumers. Indeed, research has shown that existing stadiums do have a positive impact on nearby property prices. Meanwhile, the effect of a change in performance of a team using the stadium (e.g. the team promoting to the highest league) on house prices has not yet been investigated and is therefore the aim of this study. This may be relevant for policy makers, since the outcomes of subsidies for stadiums as a tool for economic development may or may not be impaired or enhanced by the team's performance.

1.3 Aim and research questions

While capitalization effects of football stadiums have been extensively investigated, a comprehensive study of the effects of the club's success and performance and accompanied increased civic pride on nearby house prices is missing. Since promoting to the PL can be expected to have an impact on the local economy, it would be interesting to assess the effects of such an external shock on willingness to pay for a residential unit. Each season, three teams promote from the Championship to the PL, with the same number of teams going in the opposite direction. Some teams are experienced in moving up and down the leagues in England and Wales (so-called yo-yo teams), while others enter the PL after many years of relative anonymity in the Championship. In terms of a clear change in the context of performance of the area, the latter type of team would be more interesting to assess. Furthermore, yo-yo teams may experience multiple shocks in a short period; therefore it would be difficult to isolate the effect of a single event. Based on the period 2012-2015, five teams that meet the qualification to have experienced promotion after being absent for at least 5 years and have remained in the PL ever since are chosen to be assessed in this study. These teams are found in Table 1.

Other teams that also promoted in this period are Reading FC, West Ham United, Cardiff City, Hull City and Queens Park Rangers, all of whom had performed in the PL prior within 5 years before the stated promotion and all except one have relegated back to the lower Championship league since.

As described before, this study will attempt to observe the effects of performance of a team on nearby house price. Performance is proxied as an external shock: promotion to the highest, most prestigious league. The main research question is as follows:

- *What is the effect of the promotion to the Premier League of a stadium's tenant on nearby house prices in England?*

The appropriate method to investigate a change is a repeat sales method, adjusted to be similar to the difference-in-difference model as used in, for example, Gibbons and Machin (2005), who considered the effect of a change in distance to a rail station to house prices, and Kuang (2017), who investigated the effect of change in availability of information on the quality of amenities (in this case restaurants) through Yelp on house prices.

Table 1. Professional football teams promoting to the PL after a relatively long period of absence in the period 2012-2015

Club	Stadium	Season of promoting	Stadium capacity (seats)	Last year of playing in PL prior to season of promoting
Southampton	St. Mary's Stadium	2011/2012	34.000	2005
Crystal Palace	Selhurst Park	2012/2013	26.309	2005
Leicester City	King Power Stadium	2013/2014	32.243	2004
Bournemouth	Vitality Stadium	2014/2015	11.329	N.A.
Watford	Vicarage Road	2014/2015	22.200	2007

The main research question is to be answered with the help of three sub questions.
In order to obtain an extensive view on the theory's stadium capitalization, existing literature will be assessed in order to derive theories on the effect on house prices. Accordingly, the first sub question is as follows:

- *Based on theory, what is the expected effect of a successful sports team on nearby house prices?*

The second sub question will investigate five pre-identified cities to assess

- *What is the effect of a local team promoting to the Premier League on nearby house prices in Bournemouth, Leicester, Southampton, South-East London and Watford?*

This question will be answered using quantitative methods, in which the (difference in) log of price is to be explained using the promotion effect and a number of other independent variables. These regions are picked because they house a team that meets the aforementioned requirements.

Finally, the last sub question investigates potential heterogeneity in the model as it compares two distinct groups:

- *To what extent do London and non-London teams differ in the degree to which promotion affects nearby house prices?*

The remainder of this paper is organized as follows. Section 2 contains the theoretical framework and literature study. The used methodology is presented in section 3. The data is described in more detail in section 4. The results, consisting of the repeat sales analysis and heterogeneity and robustness check can be found in section 5, while the conclusion and discussion are found in section 6 and 7 respectively.

2. THEORETICAL FRAMEWORK

This section will investigate the first sub-question. In particular, the underlying mechanisms that are regarded as causal forces for increased willingness to pay for housing are of interest. A literature review will shed light on what has already been studied and the ongoing debate of economic impact of stadiums. Finally, the hypothesis for this study is formulated.

2.1 Capitalization of stadium utility

As research has shown, people are driven towards high amenity cities (Glaeser et al., 2001). Population growth in these high amenity cities has also led urban rents having increased at a faster pace than productivity and wages. The authors explained an explanation for this with the equation in (1).

(1) Urban Productivity Premium + Urban Amenity Premium = Urban Rent Premium

This points at the notion that urban rent is also explained by the amenity value of a city. Following this, it can be argued that urban rents or house prices are a result of consumers maximizing their utility.
Utility for housing can be seen as the satisfaction or happiness that a consumer derives from a house and its characteristics and is measured based on the preferences revealed in individuals' willingness to pay for that property. In the process to achieve maximum utility, the consumer is bound within a budget constraint and can distinguish between allocating funds to both private goods, such as a groceries or tickets to a football match, and public goods, such as a park or a stadium. In a simple example, a consumer can allocate funds to either non-housing goods and housing goods. This translates to in the equation (2).

(2) $\max U(x, z(z1, \ldots, zn))$ subject to $y = p(z) + x$

Where x is the non-housing good, whose price is set to unity, while z are housing characteristics and y is income. Consumers maximize their utility given their income and the set of prices for x and z.

The utility derived from housing goods depends on the size and quality of the unit they live in, as well as the quality of the surrounding environment. Given that markets are competitive and consumers mobile, an increase in utility corresponds in a higher bid rent, which can be observed in equations (1) and (3) (Ahlfeldt & Kavetsos, 2012).

(3) $r(S, L, F, D) = f[S, L(D)] + F(D)$

Here, S and L are a vector of non-locational and locational characteristics of the property, respectively, while F(D) is value of utility derived from being located within the proximity of a sports stadium (F), which is a function of distance to the stadium (D). In essence, utility maximizing behaviour results in houses being priced accordingly to both their characteristics and the features of the environment.

The monetary value derived from distance to a stadium F(D) is observable with the help of hedonic pricing analysis. Indeed, favourable nearby amenities result in a higher willingness to pay for a house. Meanwhile, negative external effects such as congestion result in lower bid rents. Thus, there is a schedule of prices for the differentiated product that is housing.

The hedonic pricing model, introduced by Rosen (1974), has shown that many neighbourhood amenities have a significant impact on house prices. Indeed, house or rent price are believed to capture environmental qualities that are otherwise not observable. Following the equation in (2), a house consists of various characteristics z1,…,zn that are believed to contribute to its utility and thus its bid rent, which can also be seen as the observed willingness to pay.

A sports stadium can also be seen as a valued public good which might influence consumers' decisions regarding the location of their house. A stadium in itself offers consumption benefits in that it regularly displays sports or concerts. Furthermore, due to size effects, a stadium may also attract other consumption amenities, such as restaurants, bars and cinemas. Finally, a sports team is believed to have an impact on local civic pride, which is a benefit that could positively influence willingness to pay for housing.

The effects of civic pride and fandom are somewhat undefined, despite their common use in public policy. Municipalities use the argument of civic pride to justify subsidies for sports teams in order to retain them in the city. Civic pride resulting from a local sports team is a non-use benefit: people can cheer for it, read about it in the news and brag about it to relatives from outside the city (Groothuis et al., 2004). Thus, sports teams provide an identity and civic pride to an area, and they might contribute to quality of life in downtown areas, as they have the potential to make a place vibrant (Johnson et al., 2012). Meanwhile, Hakes and Hutmaker (2006) found that fans nearest to the stadium value the team the most (as cited in Dehring, Depkin & Ward, 2007). These considerations suggest that people are indeed willing to pay for sports teams in their vicinity in order to maximize their utility. Indeed, some research has been employed to examine at the value of these effects. Johnson et al (2012) explored the literal willingness to pay for a sports arena in a downtown area in terms of additional tax payments. Having two Canadian cities under investigation, they found that a substantial number of inhabitants (40%) are indeed willing to pay additional taxes for teams as they believe that 'a lively and prosperous downtown improves the quality of life and engenders a sense of pride.' The present value of willingness to pay for an arena was estimated to be an additional 13 to 18 Canadian dollars for a plan with an arena compared to a plan without this arena.

Assuming people are indeed eager to pay for a sports team in their city, it should also be feasible to find an effect on house prices, due to aforementioned utility maximizing behaviour. This is, when a place is perceived to be vibrant and has a high quality of life, households are willing to pay additional money to live there. Indeed, by means of hedonic pricing analysis, research has shown that such a relationship exists, although this claim is not undisputed.

2.2 Literature review

Research on the effects of sports stadiums and arenas has been widely conducted in the European and North-American contexts. This research has often focused on the effect of announcement of a new stadium. Carolino and Coulson (2004) found that increased rents caused by introduction of an NFL franchise in American cities, was to be attributed to fandom and civic pride of individuals. Furthermore, a study by Dehring et al. (2007) suggested the same forces at work, as property values in the city of Dallas increased when the NFL's Cowboys were looking for a potential new venue in the Dallas-Fort Worth area, while prices in Dallas County decreased. Tu (2005) assessed the effect of a new sports stadium on housing values around FedEx Field in Maryland. Hedonic pricing models show that properties near the stadium were sold at a discount, however with a difference-in-difference approach, it is found that this difference existed before development of the stadium and narrowed after completion of the stadium. Thus, contrary to activists' NIMBY attitudes and claims to a stadium negatively impacting their houses, these studies showed positive effects on nearby residential property.

Similar findings have been found in more recent studies in Columbus, Ohio (Feng & Humphreys, 2018), Berlin, Germany (Ahlfeldt & Meannig, 2010) and London, England (Ahlfeldt & Kavetsos, 2013; Ahlfeldt & Kavetsos, 2014). Furthermore, Ahlfeldt and Kavetsos (2014) also found that stadium architecture plays an important role in willingness to pay for housing while Ahlfeldt and Kavetsos (2013) found that football stadiums have a negative effect in the immediate proximity but have significant positive effects on appreciation in the radius between 750 and 2000 metres. Thus, the houses located in the immediate proximity may experience the negative external effects mentioned earlier, while houses nearby benefit from consumption benefits while being too far away to experience congestion.

Based on these sources, subsidies for sports stadium with the goal of economic development seem to be justified. Nevertheless, this claim is far from undisputed. For example, Siegfried and Zimbalist (2006) are sceptical. According to them, the economic benefits of a sports team are neglectable due to substitution effect, leakage from the local economy and budgetary impact. The authors even call economic impact studies misleading and argue that the only impact a sports team may have is on public consumption externalities and enhanced community image. Similarly, Coates (2007) is also critical of the alleged economic impact of stadiums. The author calls the results presented by Carolino and Coulson (2004) and Tu (2005) unreliable[1] and notes that the Dehring et al. (2007) merely proves that a stadium causes economic redistribution rather than development. The author contends that hedonic models have not provided consensus on the benefits of stadiums. However, the fact that after Coates' (2007)

[1] According to Coates (2007), Tu (2005) ignores existence of another nearby arena which may have biased results, while Carolino and Coulson (2004) omitted too many low rent/low rent growth units from their analysis.

assessment an overwhelming number of studies have shown positive impact on property, does not provide proof for this statement.

Whether or not a new stadium has a positive impact on the local economy, is only relevant for this study in terms of background, since, in this study, presence of a stadium is already given. The change that is of interest, is the league in which the team occupying the stadium is playing, implying a proxy for increased performance. Roberts et al. (2016) concluded that the change from Championship to PL for Swansea City FC had a positive impact on the local economy, but did not look at property values. Ahlfeldt and Kavetsos (2014) directed some modest attention to performance of the teams using the Emirates and Wembley stadium. Here, the rank of Arsenal FC in the PL at the end of each season is used as a proxy for team performance, while for the other stadium the annual position of the English national team on the FIFA ranking is used. These proxies did not indicate any positive significant relationship.

The lack of any other known available work on a relationship between team performance and house prices raises a question if such a relationship could be found if another proxy for performance is assessed. This relationship could exist, based on the assumption that well performing teams generate higher utility benefits due to increased fandom, civic pride and additional consumption benefits, which should result in a higher willingness to pay for residential housing or bid rent. Therefore, the hypothesis of this study based on theory is as following:

H1 = Promotion of a team to the PL has a positive impact on nearby property prices.

3. METHODOLOGY

3.1 Repeat sales model

Given a limited amount information per transaction (chapter 4 will go into detail about this), a hedonic pricing analysis is difficult to interpret due to omitted variable bias. Nevertheless, a more useful analysis with the data is still possible with the approach of the repeat sales model.

This method was first used by Bailey, Muth and Nourse (1963) and later modified by Palmquist (1982) to allow for the effects of environmental changes. The main advantage of the repeat sale method is that it is based on actual capital gain of individual units. For this reason, it can offer better control over quantitative and qualitative characteristics of the property than hedonic regression, which control for these characteristics by using variables and parameters estimated with error (Clapp & Giaccotto, 1992).

An important disadvantage is that the method wastes data, since only properties that have been sold twice are included (Clapp & Giaccotto, 1992). Furthermore, the method does not separate house price change from depreciation, renovation between sales is ignored, the sample may not be representative of the housing stock[2] and the attribute prices may change over time (Haurin & Hendershott, 1991). Due to these disadvantages, the repeat sales analysis is often merely used to check for robustness of difference-in-difference analysis results (e.g. Schwartz et al., 2006; van Duijn et al., 2016; Zhang et al., 2019). However, in this study, the repeat sales analysis is seen as the most important and trustworthy component of the research due to the nature of the data provided.

A repeat sales model that can be used for estimating the impact of an event such as promotion to the PL on property prices can be based on the work of Lamond et al. (2007). The authors assessed the effect of a flooding event in the year 2000 on property prices and used a novel repeat sales method, using the same data source as this study.
Starting with the logarithmic price of house *i* in time period *t* in explained in in an explicit time variable hedonic model seen in equation (4).

$$(4)\quad \ln Pit = \sum_{j=1}^{J} ß j \ln X_{jit} + \gamma PL_{it} + c_t + \varepsilon_t$$

Where:

$\ln Pit$ = Log of price paid for property i at time t

$ß_j$ = vector of coefficients related to locational and property specific variables, Xit

PL_{it} = status variable indicating whether a property i is located within ring around Premier League team with coefficient γ (0 if not, 1 if yes)

[2] As Haurin and Hendershott (1991) note, houses that sell frequently may be ‘starter homes’, bought by individuals with the intend of a short stay. For this reason, these properties appear more frequently in samples of repeatedly sold houses.

c_t = generalized logarithmic market growth term

ε_t = error term

In a subsequent time period, the model for the same house is as follows.

(5) $\ln Pit{+}k = \sum_{j=1}^{J} ßj \ln X_{jit+k} + \gamma PL_{it+k} + c_{t+k} + \varepsilon_{t+k}$

Thus, the growth in price of house *i* between these two periods is given in (6).

(6) $\ln Pit{+}k - \ln Pit = \sum_{j=1}^{J} ßj \ln X_{jit+k} - \sum_{j=1}^{J} ßj \ln X_{jit} + \gamma PL_{it+k} - \gamma PL_{it} + c_{t+k} - c_t + \varepsilon_{t+k} - \varepsilon_t$

Since we assume that the characteristics regarding the locational and property specific factors remain the same, this equation is rewritten in (7).

(7) $\ln Pit{+}k - \ln Pit = \gamma(PL_{it+k} - PLit) + c_{t+k} - c_t + \varepsilon_{t+k} - \varepsilon_t$

More commonly, instead of a generalized market growth term, a set of differenced year dummies are used as indexes (Bailey et al., 1963; Eurostat, 2013). This translates into the equation in (8).

(8) $\ln Pit{+}k - \ln Pit = \gamma(PL_{it+k} - PL_{it}) + \sum_{j=1}^{T} xj + \varepsilon_{t+k} - \varepsilon_t$

Where *x* is -1 for the year of initial sale and 1 for the year of second sale. The result is similar to a market growth term, and $\hat{a}$ can be interpreted as such using $(e^{\hat{a}}-1)*100$. These estimations can be found in Appendix A (Figure I). Because of the use of -1 for year of initial sale and 1 for year of second sale, the estimation is in fact the same as in (7), since the growth rate for year of initial sale is subtracted from the growth rate of the year of second sale. Similarly, the percentage change in price due to of promotion becomes $(e^{\gamma}-1)*100$. The effect of promoting is subsequently estimated using a control group of properties that are not as near a team to the PL, resulting in a model similar to a 'difference-in-difference' approach.

The model is estimated using an OLS regression for the entire sample of houses within 10 kilometres of a stadium, using $\ln Pit{+}k - \ln Pit$ as the dependent variable and using differenced time dummies and PL status target dummy interactions as the independent variables. The significance of the promotion effect is tested within the regression context.

3.2 Application

In order to identify external effects of team promotion on nearby house prices, a repeat sales difference-in-difference analysis is presented, similar to the one used by Zhang et al. (2019).

$$(9)\quad Ln(P_{it}/P_{it+1}) = \alpha 1 Before\text{-}Post + \alpha 2 Before\text{-}Post \times Distance + \alpha 3\ Newbuild + \sum_{j=1}^{T} xj\ + (\varepsilon_t - \varepsilon_s)$$

This equation only includes time variant variables, since those that are time invariant simply become zero when subtracting Sale T from Sale T+1.

The main variable of interest is Before-Post. This is a dummy that is 1 for a sale set of a property in the target area that have been initially sold before promotion and subsequently sold after promotion. This variable interacts with distance to observe the extent to which the effect decays with distance. An additional variable is included for properties that were initially sold as a newly built property, since the status of being a newly build unit may impact price and is different between two sales by definition. Finally, the model includes differenced year dummies (*x*) and error term.

Furthermore, similar to previous research, a different model will be checked for robustness of the baseline model results. In this instance, a basic hedonic difference-in-difference model will be used, despite missing variable bias. The advantage of this model is that it uses a larger amount of the data available. In this model, the log of price in area *i* and time *t* is explained by number of individual and interacting variables. *Target* is a dummy describing whether a property is located within a predefined target area (1 if yes, 0 if no) and *Post* is a dummy describing whether the property was sold after promotion of a team within 10 kilometres of the stadium (1 if yes, 0 if no). *X* is a set of *j* property specific variables, while *y* and *u* represent year and postcode area fixed effects. Finally, ε_{it} represents the error term.

$$(10)\ Ln(P_{it}) = \beta 1 Target + \beta 2 Post + \beta 3 Target \times Post + \sum_{j=1}^{j} Xjit + y_t + u_i + \varepsilon_i$$

In short, β1 captures the difference between Target and control area prior to promotion. Furthermore, β2 is a dummy for the period after promotion. Finally, the main coefficient of interest, β3, describes the interaction effect of the area of interest with the change of interest. The coefficient describes the effect of promotion on the log of property price within the target area. This model can be extended with various distance dummies to see how this effect develops over distance.

3.3 Target and control area

Previous research by Tu (2005) has indicated that stadiums have a positive amenity effect on properties within five kilometres. This finding is further confirmed by Ahlfeldt and Kavetsos (2013) and used to determine a stadium impact difference-in-difference model by the same authors in 2014. In various studies concerning the external effects of a newly build or renovated amenity, other target and control areas are assessed. For instance, Gibbons and Machin (2005) observed new railway stations and considered a target area of 2 kilometres, based on maximum walking distance. Zhang et al. (2019) investigated a target area of 1000 meters in assessing renovated shopping centres, while Schwartz et al. (2006) used a study area of 2000 feet (0,61 km) in assessing the addition of subsidized housing units. The larger target area for the effects of promotion to the PL can be justified given that the impact of promoting to the PL is likely to have an impact on a much larger area than the amenities observed in these studies. As mentioned before, football is of high cultural significance in England and the PL is one of the most popular leagues in sports globally. Furthermore, contrary to railway stations, shopping centres and subsidized housing units, a stadium is a rather unique amenity in a city, therefore, the catchment area is much larger.

For the baseline model, a five-kilometre target area ring and a five-to-ten-kilometre control area ring will be used. This means that all sales within a five-kilometre radius from the stadium will be used as the target area, while properties located in a ring between 5 and 10 kilometres from the stadium are used as the control area. Other specifications will also be used to test for robustness in Appendix C.

4. DATA

In order to assess the potential effects of promotion to the PL on house prices, five teams and their surrounding houses are assessed, namely Leicester City, Southampton, Crystal Palace and Watford. These teams have the commonality of having promoted to the PL in the period 2012-2015 after a long period of absence in this competition and have continuously played in this league ever since to this day (June 2020). Figure 1 displays these teams on a map.

The data used for this study has been retrieved from the open data source HM Land Registry (https://landregistry.data.gov.uk/app/ppd). This source records completed property sales for value in England and Wales from 1995 to present. While the number of available transactions is high, the number of variables is limited to the address, price, date of transaction, type of building (flat, detached, semi-detached or terraced), whether the property is newly built or not, and whether the estate is a free- or leasehold.

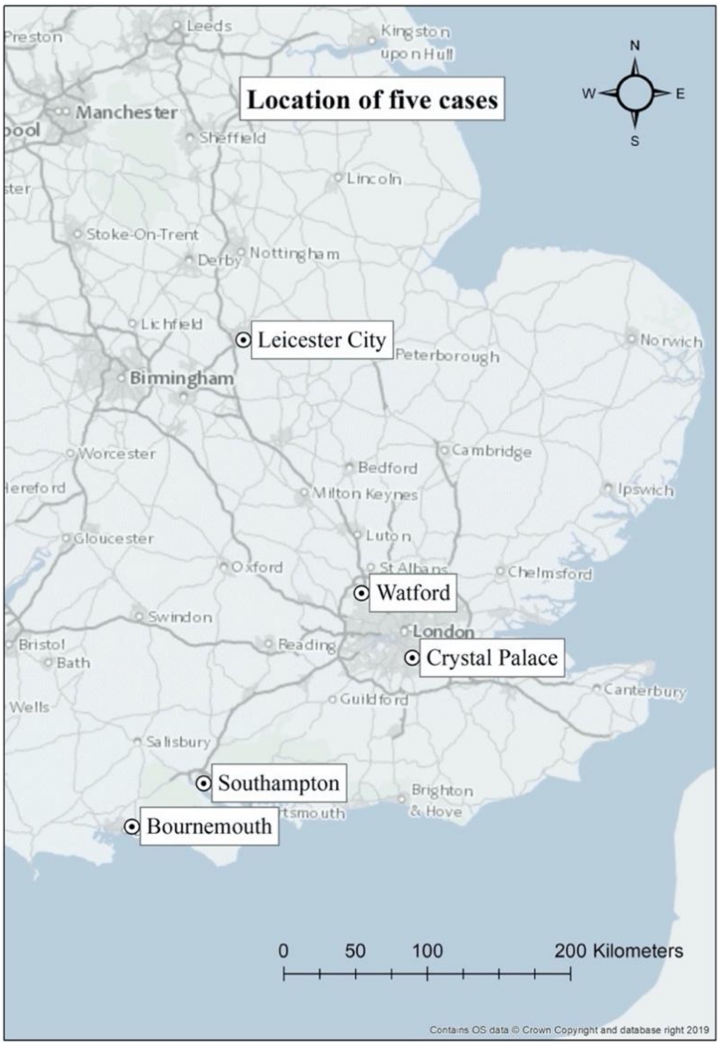

Figure 1. Map highlighting the teams in this study

In order to obtain information on the spatial relationship between sold properties and the nearest football stadium, a point layer postal code dataset from Ordnance Survey is used to calculate Euclidean distances to the nearest football stadium in ArcMap and is subsequently linked to the transaction data by means of the 'Join by attribute' function. The postal code point layer is modified to only include points within a buffer of 10 kilometres around a football stadium of interest, which are specified in Table 1. In terms of price paid, transactions that are deemed to be unreasonably low (< 30.000 GBP), are dropped (28 observations). The initial dataset contains 243.540 unique transactions in the period of January 1, 2010 to April 9, 2020 located within 10 kilometres of the football stadium of interest, including information regarding distance to the nearest stadium. The descriptive statistics for this dataset can be found in Table I in Appendix A. Furthermore, correlation matrices for repeat sale and hedonic variables are found as Table II and III in Appendix A.

Organizing the data to make it fit for repeat sales analysis is a data wasting process. Indeed, 62,74% of all unique transactions are of properties that are sold only once in the period of interest. These observations are not used. The operational dataset contains 36.859 instances of a property that is sold twice in the period and location of interest.

Table 2 contains descriptive statistics for properties that are used for repeat analysis. It is important to note that the variables of distance, estate type and property type are not used in the regression, since these are constant for both sales and cancel each other out.

Price difference is much higher for properties around Watford and Crystal Palace, two teams in or around the vicinity of London. Furthermore, the areas consist of a fairly different composition of property types. Detached properties are rare around Crystal Palace's ground, while prevalent in Bournemouth. Flats are uncommon in Leicester, but widespread around Crystal Palace and Bournemouth.

Transactions for newly build properties are similar for all areas, which represent around 11% of the total transactions. This cannot be said for distribution of estate types. Many properties in Leicester are sold as a freehold, which means the buyers obtain the property and land in perpetuity. This type of sale is a minority in the Crystal Palace area, where a leasehold is more common. This implies the land is not actually obtained by the buyer and, among other things, the leaseholder has to pay an annual ground rent to the freeholder.

We can further observe that differences per case in terms of Distance, Newbuild, Estate type and Property type are, in general, not different from findings in Table I, which proves that data adjustments did not impact any category in particular and that the sample of properties that are sold twice do not differ from the sample of all unique transactions

However, average price is on average higher for transactions for properties that were sold multiple times compared to all unique transactions. This difference is significantly different from zero Overall, 34% of properties in the sample is located in the target area and was sold both before and after promotion of a nearby team.

Table 2. Descriptive statistics for properties that have sold twice between 2010 and 2020. Price difference is in GBP, distance in Euclidian metres to stadium.

	Leicester (N=7.835)		**Crystal Palace (N=7.195)**		**Bournemouth (N=7.975)**	
Variable	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Price difference	36.110	55.047	117.839	109.930	55.399	67.756
Price average	195.947	100.261	394.534	197.697	277.393	153.496
Distance	5.078	2.679	3.188	1.501	3.812	2.328
Newbuild*	0,14	0,35	0,08	0,26	0,07	0,25
Before-Post**	0,28	0,45	0,42	0,49	0,43	0,50
Estate type***	0,89	0,32	0,43	0,49	0,51	0,50
Property type (%)						
Detached	21,02		2,97		27,74	
Semi Detached	35,20		12,02		12,38	
Flat	10,80		52,03		48,19	
Terraced	32,98		32,98		11,69	
	Southampton (N=10.005)		**Watford (N=3.849)**		**Total (N=36.859)**	
Variable	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Price difference	45.124	48.926	116.916	112.040	67.112	84.159
Price average	245.957	125.078	413.144	253.541	288.590	178.818
Distance	4.826	2.593	3.524	2.019	4.205	2.437
Newbuild*	0,09	0,28	0,13	0,33	0,10	0,30
Before-Post**	0,20	0,40	0,51	0,50	0,34	0,47
Estate type***	0,68	0,47	0,59	0,49	0,63	0,48
Property type (%)						
Detached	19,41		10,32		18,23	
Semi Detached	23,41		19,43		21,59	
Flat	28,90		39,85		34,13	
Terraced	28,28		30,40		26,05	

Variable is dummy for prior sale (0=no, 1=yes) **Variable is dummy (0=other, 1=in target area, sale before and after promotion) * Variable is dummy (0=Leasehold, 1=Freehold)*

5. RESULTS

Given the methodology and provided data, this section will yield results that will help answer sub-questions 2 and 3. The baseline model is first presented, after which some modifications are assessed regarding possible heterogeneity in the model. Finally, a hedonic difference-in-difference model is presented for robustness. The results will be discussed and linked to theory in the subsequent chapter.

5.1 Baseline specification

The baseline model has a target area of 5 km around the stadium and control area between 5 and 10 km from the stadium. The main coefficients are reported in in Table 3.

The main variable of interest, Before-Post, has a coefficient that is significantly different from zero. The effect of experiencing promotion between two sales in the target area is a price increase of 7,68%, given that distance is held constant (Distance=0). This implies a positive external effect of promotion to the PL to property prices. The interaction effect with distance itself is not significantly different from zero, therefore, it is not possible to state whether this effect is decaying or increasing with distance within the target area. The R-squared value of the model is 0,6508, which implies that 65,1% of variance in price difference is explained by the baseline model. This is a slight increase compared to the model that does not include variables related to promotion and stadium location.

Table 3. Results of baseline repeat sales analysis

Sample	**<10.000 m**	**<10.000 m**
Target area	**0-5.000 m**	**0-5.000 m**
Control area	**5.000-10.000 m**	**5.000-10.000 m**
Transition: Before-Post		0,074** (2,01)
Before-Post*Distance		9,34e-06 (0,69)
Sale 1 Newbuild	Included	Included
Differenced year dummies	Included	Included
Property type	Excluded	Excluded
Estate type	Excluded	Excluded
Zip code fixed effects	Excluded	Excluded
Adj. R-squared	0,6399	0,6508
N	36.279	36.279

Note: Dependent variable is the log difference in price paid. Standard errors are clustered on postcode area level. T-statistics in parentheses.

**p<0,10 **p<0,05 ***p<0,01*

Although using the 5 km target area was a decision made according to theory, it is an arbitrary decision and therefore questionable. For reasons of transparency, results for alternative target and control areas are shown in Appendix B, Table IV. The results reinforce the finding that promotion of a team has a positive external impact on nearby house prices, regardless the cut-off of the target and control area.

5.2 Heterogeneity and robustness

The analysis above shows the overall analysis for five promoted teams in England and their effect on the local property market. Meanwhile, Table 2 may have raised questions regarding the extent to which these markets can be generalized, since the average price increase and characteristics of the properties in areas in and around London (Crystal Palace and Watford) have shown to be different compared to areas outside the influence of England's capital (Southampton, Leicester and Bournemouth). For this reason, it would be interesting to see whether the model performs differently when the restricted model is relaxed and is instead run for London teams and non-London teams separately and, therefore, whether heterogeneity exists. Table 4 reports findings for this operation.

Table 4. Results of unrestricted repeat sales analysis

Sample	**<10.000 m**	**<10.000 m**
Target area	**0-5.000 m**	**0-5.000 m**
Control area	**5.000-10.000 m**	**5.000-10.000 m**
	London teams (2)	**Other teams (3)**
Transition: Before-Post	0,13*** (4,25)	0,028** (2,27)
Before-Post*Distance	-1,97e-06 (-0,16)	0,00001** (2,47)
Sale 1 Newbuild	Included	Included
Differenced year dummies	Included	Included
Property type	Excluded	Excluded
Estate type	Excluded	Excluded
Zip code fixed effects	Excluded	Excluded
Adj. R-squared	0,7897	0,6298
N	11.044	25.235

Note: Dependent variable is the log of difference in price paid. Distance is in metres. Standard errors are clustered on postcode area level. T-statistics in parentheses.
**p<0,10 **p<0,05 ***p<0,01*

In both models, the external effect of promotion is indeed positive. Actually, this effect is much stronger for London teams. The effect for a property directly adjacent to the stadium in London after promotion is 13,6%. As for the other teams, this effect is limited to 2,84% and increases with distance within the target area. Overall, the R-squared statistic is higher for the London teams model, which indicates that the model is more effective in explaining variation in price differences in London than in the other areas under study. A Chow F-Test based on the regression without clustered standard errors, which can be found in Appendix C, further confirms this finding.

Table 5. Results of hedonic difference-in-difference analysis

Sample	**<10.000 m**	**<10.000 m**
Target area	**0-5.000 m**	**0-5.000 m**
Control area	**5.000-10.000 m**	**5.000-10.000 m**
	Model 1	**Model 2**
Target	-0,046* (-1,84)	
Target * Post	0,056*** (2,89)	
Promotion	-0,014 (-1,20)	-0,014 (-1,16)
Target (0-1 km)		-0,194*** (-4,07)
Target (1-2 km)		-0,066 (-1,66)
Target (2-3 km)		-0,062 (-1,60)
Target (3-4 km)		-0,051 (-1,42)
Target (4-5 km)		-0,033 (-1,22)
Target (0-1 km) * Post		0,083 (1,58)
Target (1-2 km) * Post		0,047* (1,79)
Target (2-3 km) * Post		0,057* (1,76)
Target (3-4 km) * Post		0,056** (2,53)
Target (4-5 km) * Post		0,053** (2,01)
Newbuild	Included	Included
Estate type	Included	Included
Property type fixed effects (3)	Included	Included
Year fixed effects (10)	Included	Included
Zip code fixed effects (50)	Included	Included
Constant	12,5*** (250,95)	12,5*** (250,51)
Adj. R-squared	0,6734	0,6748
N	243.885	243.885

Note: Dependent variable is the log of price paid. Standard errors are clustered on postcode area level. T-statistics in parentheses.
**p<0,10 **p<0,05 ***p<0,01*

As stated in sections 3 and 4, various important variables are missing in the data, which could potentially cause omitted variable bias. The most important may be a variable illustrative to the size of a property. Nevertheless, given the available data it could still be interesting to examine the effect the present variables may have on the paid price. The main advantage of this method over the repeat sales approach is that is does not waste data. Table 5 shows two models regressing the log of price paid. The results in the models are quite interesting, particularly the interaction variables of interest. The first model shows a weak significant negative effect for being located in the target area without the effect of promotion, whereas this effect is positive and strongly significant with promotion. Indeed, being in the target area after promotion has a marginal effect of 5,76% on property price. This implies once more a positive external effect of promotion on houses in the nearby area.

Model 2 displays an alternative specification to show the effect of distance in a non-linear fashion. Distance rings within the target area again show a negative effect on property prices without the effect of promotion, although this effect is mostly insignificant. Implementing the effect of promotion changes the sign of the coefficients: the effect is positive for all rings compared to the control area, and this effect is mostly significant. Furthermore, what is can be noted is the irregular decrease of the effect moving away from the control area. The coefficient is highest in the ring directly next to the stadium, yet, insignificant. The positive effect is notably present for properties located between 2 and 5 kilometres from the stadium.

6. DISCUSSION

In addition to the finding that stadiums have a positive effect on willingness to pay for housing in an English context (Ahlfeldt & Kavestos, 2013, 2014), the results in this study have shown that the shift from being a Championship team to being a Premier League team may have a distinct effect on nearby property prices. Although the extent of the effect varies per specification, the sign of the coefficients have uniformly shown that promotion has a positive effect on nearby house prices. This is in line with conclusions based on theory: a promoted team results in a higher amenity area, which generates higher willingness to pay for residential housing. Therefore, this study is further proof that urban rent premium is in part a function of amenity premium (Glaeser et al., 2001). These results are based on five different cases that share the commonality of being promoted in a certain period after a long period of absence in the PL. This has implications to an extent that the results explain the generalized effect of promotion, since, as argued earlier, the effect of promotion in an area that did not experience any recent promotion could be stronger than for an area whose local team promotes and relegates regularly. There has to be a clearer shock in terms of civic pride and external consumption benefits in those areas where the promotion was not experienced in a longer period of time. For the interest of this study, only the cases with this clear shock were assessed to obtain an isolated effect of promotion on property prices.

The applied methodology, in which an inner ring is compared to an outer ring, suggests that redistributive forces are at work, similar to what Dehring et al. (2007) pointed out for house prices in Dallas, Texas. This implies that the area around the stadium becomes more attractive to live in after promotion, compared to the area further away from the stadium. However, it could also be the case that the entire city or region benefits from promotion, as is indicated by Roberts et al. (2016) in economic impact in Swansea, Wales. This implies that the whole city or region becomes more attractive to reside in, but the areas around the stadium benefit to a larger extent. To investigate whether this is true would require a different methodology, in which a city that does not experience promotion is (to be) compared to a city that does experience promotion.

According to the baseline model, promotion increases price differences directly adjacent to the stadium by 7,68%. Unfortunately, it is not clear whether this changes with distance within the target area, since the obtained coefficient is not significant. The results in the other models show a mixed sign. For example, in the model with only non-London teams from Table 4 the sign is positive, indicating an increase with distance from the stadium. Model 2 in Table 5 indicates the relationship with distance is actually non-linear, since the effect is strongest not adjacent to the stadium, but rather 2 km away from the stadium. This result is line with findings from Ahlfeldt and Kavetsos (2013), who found that the impact of a stadium increases further away from the stadium, although they found this reaches a maximum at only 1 km away, after which a smooth decay was observed. Indeed, it could be the case that promotion does not necessarily impact the nearest properties in a positive way, due to anticipated extra negative externalities, such as extra noise and crowds attracted by the promoted team. However, the area around the stadium as a whole experiences the increased consumption benefits of having a team in the highest League and, therefore, an increased willingness to pay for residential property is evident.

Conducting analysis for London teams and other teams separately does not yield different outcomes in terms of sign. However, a remarkable finding is the stronger effect of promotion for the teams in London compared to the effect for the other teams: the effect of promotion for units in the target area is 13,6% and 2,84% respectively, the latter being the conservative estimate in this study. The reason for this difference may be found in using the theory of utility maximalization in relation to the bid rent for residential areas. An implicit assumption is that the market is competitive and consumers mobile; therefore, any increase in utility will instantly lead to an increase in price (Ahlfeldt and Kavetsos, 2012). As the housing market in London can be regarded as more competitive than the housing market of Leicester, Bournemouth and Southampton, an increase in utility from a football team will translate more effectively in a higher bid rent than in the latter areas. Whether this is actually true could be an avenue for future research. The present study involves 5 cases, which is not enough to assert anything about regional differences. A more extensive study involving more time periods could involve more cases, making it possible to look into differences in spatial characteristics.

A more likely explanation may be based on the used methodology. To assure that the assessed property prices developed within the same geographic context, the analysis is conducted by using rings for target and control areas in the same city. In such a model, it is implicitly assumed that the area around the stadium will be more heavily impacted than the area in the control ring, due to proximity. In reality, promotion of a team could have a 'PL effect' for the whole city, thereby also impacting price development in the control area. In Bournemouth, Leicester and Southampton, the team studied is the only professional football team in their respective city. London is by all means a 'Premier League city', housing 6 teams in 2020, therefore the effect of an additional team may not have a large impact on the city as a whole or the control area, but will impact the area around the stadium. It can therefore be argued that using London as a context for this study suits the used methodology better, which has evidently translated into the obtained results.

Investing public funds in maintaining or attracting sports stadiums has become a prominent policy tool for to generate economic development. Literature has shown that a stadium does have a positive external effect on nearby property. Assuming that economic development in an area also translates into increased property prices, this study has found evidence that the outcome of these investments is in part dependent on the performance of the team using the stadium, which is outside the influence of the policymaker. Furthermore, since we have seen positive effects of promotion on nearby property, promotion of a team could initiate or strengthen a process of gentrification in the area around the stadium. The game of football has traditionally been an affair for primarily working-class males; hence, football stadiums are often found in areas characterized by the working-class. Amongst other things, commercialization, commodification and internationalization of the PL have attracted audiences from all over the world and of all socio-economic groups, driving up ticket prices to an extent that those of lower socio-economic status may subsequently be excluded from attending a match in the PL (Crabbe & Brown, 2004; Wagg, 2004). If property prices around the stadium also increase, the same group could be at risk of also being displaced from their neighbourhood. Any city government that strives to act *just*[3] should at least consider this when investing in stadiums with the intent of economic development.

[3] According to Moroni (2019), a just city is a city whose institutions act just. In this instance an institution could be just if it would not contribute to the involuntary displacement of citizens in a low socio-economic position.

7. CONCLUSION

The aim of this study has been to investigate the effect of promotion to the Premier League on nearby property prices. For this, analyses on theory and repeatedly sold units were conducted. A repeat sales analysis was used to obtain the effect of promotion in a target area of 5 kilometres around the stadium in a sample of repeated sales of 10 kilometres around the stadium. This difference-in-difference approach resulted in positive external effects of promotion on nearby property. The effect differs per specification. The most conservative estimate indicates a price increase of 2,84% if distance from the stadium is 0. Unfortunately, it cannot be asserted whether this effect increases or decreases with distance. This might occur because of the non-linearity in the relationship of price increase with distance. A hedonic analysis showed that effects were significant from 1 kilometre onwards, which is in accordance with theory on stadium impact. The effect of promotion was robust when using other target and control areas, while also showing similar signs when estimating for London teams and other teams separately. However, the effect for London teams seems to be much stronger than for other teams, which could be seen as evidence that the used methodology suits a large agglomeration such as London better.

To the best of the author's knowledge, this study has been the first to focus on the relationship between sports performance and property prices. As this study observes one particular country, proxy for performance and affected real estate sector, there is plenty of room for further research. Professional sports are of high cultural significance in many countries; therefore, this study can be implemented elsewhere. Some countries, such as the US, are not familiar with a system of promotion and relegation. Here, another proxy could be used, such as victory of a championship or formation a so-called dynasty, where a team dominates the league for an extended length of time. Since teams and stadiums are often subsidized with the argument to contribute an economically vibrant area, it would also be interesting to look at the effects for other real estate sectors, for example office or retail rents. With these extensions, a better understanding of the consumer city might be obtained.

Furthermore, a limitation of this research has been the limited number of assessed teams. This does not only provide difficulty in generalizing results for England or Europe, it also caused a multicollinearity problem between time related variables, such as promotion, year and a trend related variable. Research involving a larger variety in assessed teams could bypass these limitations and provide answers to questions regarding the temporal development of PL promotion effects on residential property. This could indicate whether effect of promotion diminishes or strengthens as time passes by.

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Appendix

a. Descriptive statistics

Table I. Descriptive statistics for initially assessed cases. Price is in GBP, distance in Euclidian metres to stadium.

	Leicester (N=58.661)		Crystal Palace (N=53.608)		Bournemouth (N=45.353)	
Variable	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Price paid	188.697	104.014	340.747	185.047	265.180	151.110
Distance	5.032	2.571	3.166	1.504	3.642	2.349
Newbuild*	0,12	0,33	0,08	0,27	0,06	0,24
Promoted*	0,64	0,48	0,72	0,44	0,50	0,50
Estate type**	0,91	0,29	0,48	0,50	0,56	0,49
Target*	0,51	0,50	0,90	0,30	0,75	0,44
Property type (%)						
Detached	25,5		4,25		34,15	
Semi Detached	36		13,25		12,85	
Flat	8,75		51,5		42,75	
Terraced	29,75		31		10,25	
	Southampton (N=59.452)		**Watford (N=26.728)**		**Total (N=243.540)**	
Variable	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Price paid	237.466	127.923	417.437	313.033	273.419	185.623
Distance	4.820	2.613	3.510	2.014	4.181	2.407
Newbuild*	0,08	0,27	0,10	0,29	0,09	0,28
Promoted*	0,82	0,37	0,43	0,50	0,66	0,47
Estate type**	0,70	0,45	0,67	0,47	0,67	0,47
Target*	0,57	0,49	0,78	0,41	0,69	0,46
Property type (%)						
Detached	25		17,4		21,4	
Semi Detached	24		14,4		22,5	
Flat	26		32		31,3	
Terraced	25		26,2		24,8	

**Variable is dummy (0=no, 1=yes) **Variable is dummy (0=Leasehold, 1=Freehold)*

Table II. Correlation matrix for repeatedly sold units data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)LnPriceDiff	1,0000													
(2)Before Post*	0,2427	1,0000												
(3)NewBuild S1*	-0,1364	-0,0030	1,0000											
(4)ΔYear 2010	0,0160	-0,1316	0,0091	1,0000										
(5)ΔYear 2011	-0,0654	-0,1906	-0,0211	-0,2433	1,0000									
(6)ΔYear 2012	-0,1465	-0,1550	-0,0273	-0,2300	-0,1919	1,0000								
(7)ΔYear 2013	-0,1680	-0,0331	-0,0117	-0,2328	-0,1947	-0,1396	1,0000							
(8)ΔYear 2014	-0,0327	0,0572	0,0120	-0,2143	-0,1917	-0,1476	-0,0993	1,0000						
(9)ΔYear 2015	0,0641	0,1963	0,0151	-0,1346	-0,1325	-0,1279	-0,1097	-0,0770	1,0000					
(10)ΔYear 2016	0,1261	0,1840	0,0102	-0,0460	-0,0726	-0,0860	-0,1067	-0,1092	-0,0822	1,0000				
(11)ΔYear 2017	0,1231	0,0900	0,0153	0,0282	-0,0089	-0,0430	-0,0802	-0,1244	-0,1416	-0,1294	1,0000			
(12)ΔYear 2018	0,0689	-0,0191	-0,0016	0,0906	0,0547	0,0049	-0,0609	-0,1260	-0,1682	-0,2052	-0,2054	1,0000		
(13)ΔYear 2019	-0,0057	-0,0918	-0,0046	0,1260	0,0931	0,0370	-0,0267	-0,1026	-0,1825	-0,2393	-0,2648	-0,2587	1,0000	
(14)ΔYear 2020	-0,0068	-0,0285	-0,0109	0,0326	0,0285	0,0151	0,0015	-0,0317	-0,0339	-0,0596	-0,0839	-0,0807	-0,0710	1,0000

Table III. Correlation matrix for unique transaction data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Price paid	1.0000						
(2) Distance	0.0852	1.0000					
(3) Year	0.1876	0.0151	1.0000				
(4) Newbuild*	0.0033	0.0405	-0.0253	1.0000			
(5) Estate type**	0.2275	0.2701	-0.0139	-0.1367	1.0000		
(6) Promoted*	0.1291	0.0325	**0.7668**	-0.0103	-0.0261	1.0000	
(7) Target*	-0,0464	**-0,8273**	-0,0203	-0,0466	-0,2610	-0,0292	1,0000

**Variable is dummy (0=no, 1=yes) **Variable is dummy (0=Leasehold, 1=Freehold*

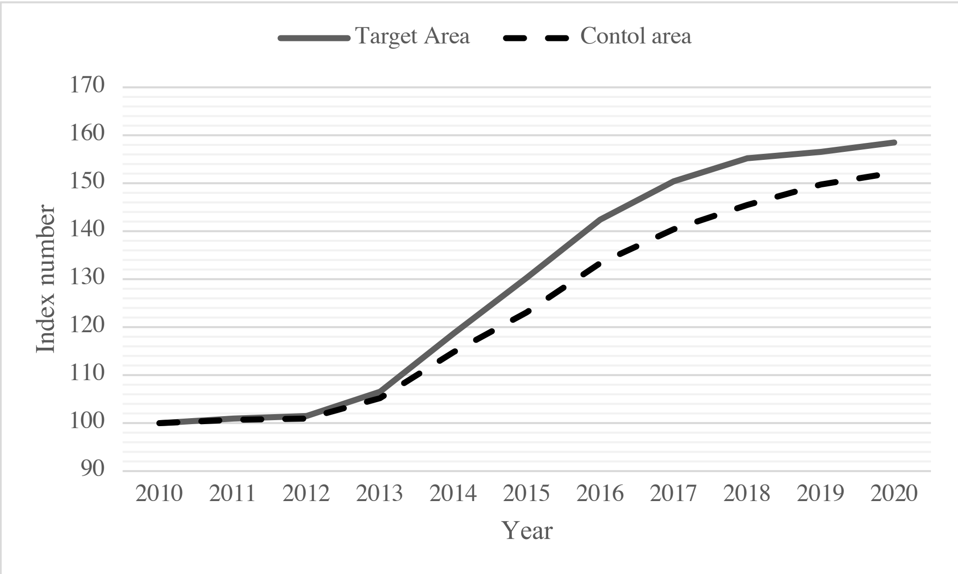

Figure I. Price development in the target and control area since 2010

b. Alternative specifications

Table IV. Results of repeat sales analysis using various target and control areas

Sample	**<6.000 m**	**<4.000 m**	**<2.000 m**	**<1.000 m**
Target area	**0-3.000 m**	**0-2.000 m**	**0-1.000 m**	**0-500m**
Control area	**3.000-6.000 m**	**2.000-4.000 m**	**1.000-2.000 m**	**500-1.000 m**
Transition: Before-Post	0,063 (1,33)	0,107* (1,73)	0,194*** (2,93)	0,281*** (4,47)
Before-Post*Distance	0,00001 (0,56)	-0,00002 (-0,52)	-0,0001 (-1,44)	-,0006**(-2,87)
Sale 1 Newbuild	Included	Included	Included	Included
Differenced year dummies	Included	Included	Included	Included
Property type	Excluded	Excluded	Excluded	Excluded
Estate type	Excluded	Excluded	Excluded	Excluded
Zip code fixed effects	Excluded	Excluded	Excluded	Excluded
Adj. R-squared	0,6726	0,6733	0,6336	0,6716
N	27.153	18.846	7.048	1.518

Note: Dependent variable is the log of difference in price paid. Distance is in metres. Standard errors are clustered on postcode area level. T-statistics in parentheses.
**p<0,10 **p<0,05 ***p<0,01*

c. Chow F Test

The Chow F Test is used to assess whether a restricted or unrestricted model fits the data best. The test calculated with the following equation (Brooks and Tsocalos, 2010):

$$\frac{RSS-(RSS1+RSS2)}{RSS1+RSS2} \times \frac{N-2K}{K}$$

where RSS = residual sum of squares for the whole sample;
RSS1 = residual sum of squares for sub-sample 1 (in this case London);
RSS2 = residual sum of squares for sub-sample 2 (in this case other);
N = number of observations;

2k = number of regressors in the ‘unrestricted’ regression (as it comes in two parts), and
k = number of regressors in (each) ‘unrestricted’ regression.

Regression	N	RSS
Pooled	36.279	1341,86
London	11.044	408,49
Other	25.235	702,52
No of variables (k)	14	
F(14, 27.722)	538,02	

The resulting F score is far higher than the critical value that associated to the degrees of freedom, therefore the the independent variables have different impacts on the two subgroups in this study.

d. Do-file stata analysis

```
***Do File REMT all data***

use "/Users/Robbert/Documents/Real Estate Studies 2019-2020/MT Course/AllData.dta", clear

**Data cleaning and generating***
gen postcodenew2 = substr(PostcodesOriginalformat, 1, length(PostcodesOriginalformat) - 3) + " " +
substr(PostcodesOriginalformat, -3, 3)
split postcodenew2, parse(" ")
drop postcodenew23 postcodenew22 postcodenew2
encode postcodenew21, generate(postcodearea)
drop NEAR_FID DistancetoNearestNavigation Within5kmofanavigation Within1kmofanavigation
NearestKMLength NearestNavigation ExternalRegion OperationalRegion Postcodesnospaces
PostcodesOriginalformat Northings Eastings OBJECTID
drop if transaction_category == "B"
drop if price_paid < 30000
generate lnpricepaid = ln(price_paid)
gen yr=year(deed_date)
label define Area 1 "Watford" 2 "Southampton" 3 "Bournemouth" 4 "Leicester" 5 "Crystal Palace"
label values Area Area
generate newbuild = 0
replace newbuild =1 if new_build== "Y"
generate DistanceKM = NEAR_DIST/1000
drop new_build
generate estatetype = 0
replace estatetype = 1 if estate_type =="F"
label define Estatetype 1 "Freehold" 0 "Leasehold"
label values estatetype Estatetype
label define NewBuild 1 "Yes" 0 "No"
label values newbuild NewBuild
generate propertytype = 0
replace propertytype =2 if property_type == "S"
replace propertytype =3 if property_type == "F"
```

```
replace propertytype =4 if property_type == "T"
replace propertytype =1 if property_type == "D"
label define PropertyType 1 "Detached" 2 "Semi-detached" 3 "Flat" 4 "Terraced"
label values propertytype PropertyType
drop property_type estate_type
tostring paon, replace
drop if NEAR_DIST ==.
recode NEAR_DIST 0/1000= 1 1000.001/2000=2 2000.001/3000=3 3000.001/4000=4 4000.001/5000=5
5000.001/max=6, generate(ordinaldistance)
label define ordinaldistance 1 "<1km" 2 "1-2km" 3 "2-3km" 4 "3-4km" 5 "4-5km" 6 ">5km"
label values ordinaldistance ordinaldistance
recode NEAR_DIST 0/5000=1 5000.0001/max=0, generate(nearbystadium5km)
recode NEAR_DIST 0/3000=1 3000.0001/max=0, generate(nearbystadium3km)
recode NEAR_DIST 0/2000=1 2000.0001/max=0, generate(nearbystadium2km)
recode NEAR_DIST 0/1000=1 1000.0001/max=0, generate(nearbystadium1km)
recode NEAR_DIST 0/500=1 500.0001/max=0, generate(nearbystadium500m)
label define nearbydummy 1 "Yes" 0 "No"
label value nearbystadium5km nearbystadium3km nearbystadium2km nearbystadium1km
nearbystadium500m nearbydummy

generate promoted = 0
replace promoted = 1 if Area == 1 & deed_date >= td(2may2015)
replace promoted = 1 if Area == 2 & deed_date >= td(28april2012)
replace promoted = 1 if Area == 3 & deed_date >= td(2may2015)
replace promoted = 1 if Area == 4 & deed_date >= td(4april2014)
replace promoted = 1 if Area == 5 & deed_date >= td(27may2013)
label define promoted 0 "No" 1 "Yes"
label values promoted promoted
tab promoted


** Descriptive statistics and regression incl interaction**
sum
corr price_paid DistanceKM yr newbuild estatetype promoted
tab propertytype
reg lnpricepaid i.nearbystadium5km i.nearbystadium5km#i.promoted
i.nearbystadium5km#i.promoted#c.NEAR_DIST i.propertytype i.estatetype i.newbuild i.yr
i.postcodearea, vce(cluster postcodearea)
*nb. change targetdummies accordingly to control and target area

***Prepare for repeat sales***

**Create identifier for i and delete all single sales**
gen address = street + paon + saon
egen BuildingID = group(address)
duplicates report BuildingID
sort BuildingID
duplicates tag BuildingID, generate(repeats)
keep if repeats >0
keep if repeats <4
sort BuildingID deed_date

** Delete all repeat sales that happened on the same date **
duplicates tag deed_date BuildingID, generate(duplicatedate)
```

```
sort duplicatedate BuildingID
drop if duplicatedate==1
**look for units and drop where postcode is not consistent with address**
duplicates tag postcode BuildingID, generate(nonsimilarpostcode)
tab nonsimilarpostcode
drop if nonsimilarpostcode ==0
**Create j variable that is different for each pair of BuildingID**
sort BuildingID deed_date
by BuildingID: gen saleno = _n

**Drop all variables that wont be used in analysis**
drop unique_id  saon paon street town district county locality
**Generate using wide format, drop units that were resold in the same year**
bysort BuildingID: drop if yr == yr[_n-1]
duplicates tag BuildingID, gen(repeats2)
drop if repeats2 == 0

bysort BuildingID: gen lndiffprice = ln(price_paid/price_paid[_n-1])
bysort BuildingID: gen diffprice = price_paid-price_paid[_n-1]


*Generate the variable of interest
gen beforepost = 0
bysort BuildingID: replace beforepost = 1 if promoted[_n-1] == 0 & promoted ==1 & nearbystadium5km
== 1

generate newbuildsale1 = 0
bysort BuildingID: replace newbuildsale1 =1 if newbuild[_n-1] == 1

**Generate differenced year dummies**
sort BuildingID deed_date
generate difyear2010 = 0
bysort BuildingID: replace difyear2010 = -1 if yr[_n-1] == 2010

generate difyear2011 = 0
bysort BuildingID: replace difyear2011 = -1 if yr[_n-1] == 2011
replace difyear2011 = 1 if yr == 2011

generate difyear2012 = 0
bysort BuildingID: replace difyear2012 = -1 if yr[_n-1] == 2012
replace difyear2012 = 1 if yr == 2012

generate difyear2013 = 0
bysort BuildingID: replace difyear2013 = -1 if yr[_n-1] == 2013
replace difyear2013 = 1 if yr == 2013

generate difyear2014 = 0
bysort BuildingID: replace difyear2014 = -1 if yr[_n-1] == 2014
replace difyear2014 = 1 if yr == 2014

generate difyear2015 = 0
bysort BuildingID: replace difyear2015 = -1 if yr[_n-1] == 2015
replace difyear2015 = 1 if yr == 2015
```

```
generate difyear2016 = 0
bysort BuildingID: replace difyear2016 = -1 if yr[_n-1] == 2016
replace difyear2016 = 1 if yr == 2016

generate difyear2017 = 0
bysort BuildingID: replace difyear2017 = -1 if yr[_n-1] == 2017
replace difyear2017 = 1 if yr == 2017

generate difyear2018 = 0
bysort BuildingID: replace difyear2018 = -1 if yr[_n-1] == 2018
replace difyear2018 = 1 if yr == 2018

generate difyear2019 = 0
bysort BuildingID: replace difyear2019 = -1 if yr[_n-1] == 2019
replace difyear2019 = 1 if yr == 2019

generate difyear2020 = 0
replace difyear2020 = 1 if yr == 2020

**Repeat Sales regression**

reg lndiffprice i.beforepost i.beforepost#c.NEAR_DIST newbuildsale1  difyear2010 difyear2011
difyear2012 difyear2013 difyear2014 difyear2015 difyear2016 difyear2017 difyear2018 difyear2019
difyear2020 if NEAR_DIST<= 10000, vce(cluster postcodearea) noconstant

display "adjusted R2 = " e(r2_a)

generate londonteam = 0
replace londonteam = 1 if Area == 1
replace londonteam = 1 if Area == 5
```