
Spatial Differentiation of Urban Property Prices as a Repercussion in the Aftermath of a Civil Disorder Incident: The 2011 London Case

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Abstract:

Purpose: The purpose of the paper is to explore possible consequences on property prices in areas of London, ensuing the civil unrest of 2011.

Design/Methodology/Approach: We studied the repercussion of the civil unrest on real estate prices through the application of a difference in differences method of analysis. The case of London was chosen due to its well-developed property market and the availability of adequate, high quality and detailed data needed for this purpose.

Findings: It was found that up to one year period after the end of the unrest, the effect seems to be statistically insignificant. The findings further suggest, that during the second and third year from the end of the turmoil, the civil unrest led to an approximately 5% decline in property prices in the affected areas of London.

Practical Implications: This research study is an attempt to quantify the impact of London 2011 riots on property prices. The duration of the effect reflecting people's perception regarding the risk associated with investing in these areas has not been determined. Riots combine the economic and the social impact.

Originality/Value: Policy makers can better understand and estimate the repercussions of how urban economies interact with population and absorb localized ephemeral events. In that sense, it can be a vital aid in the hands of the administration in its duties to shape a more balanced and harmonic urban environment. Every shock though has its own distinct characteristics and doesn't affect the spatial dynamics in a uniform fashion across time.

Keywords: House prices, civil disorder, London.

JEL codes: C31, R21, R31.

Paper Type: Research study.

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1. Introduction

Sustainable cities and communities represent the 11th goal of the 17 principles, that comprise the 2030 Agenda for Sustainable Development. In this framework the eleventh goal is dedicated to the provision for adequate housing with access to basic infrastructure (for water, sanitation, appropriate waste management), public transportation and health-care facilities that are necessary to make cities and human settlements inclusive, safe, resilient and sustainable. Appropriate housing facilities are necessary in providing people with the necessary dignity, relative comfort and security as human beings (UN, 2020).

“Investment in housing represents the largest single source of wealth for individuals and has an important role in the macro economy” (Reed, 2001). It is well known that “housing is a major component of wealth and houses are risky assets with volatile prices which carry substantial value” (Campbell *et al.*, 2004) The most well known fundamental factors that determine affordable house prices are disposable income, financial wealth, interest rates, property value taxes, infrastructures, unemployment rates, mortgage loans, the level of rents, the housing stock, its age, the demographics, the political situation, etc., (Skaarup, 2010; Reed, 2001). It is naturally expected that any substantial divergence from the above fundamental factors that are determining (under normal circumstances) the supply and demand of housing, “it is more likely that the specific market becomes more vulnerable to price correction” (Geng, 2018).

There are also extraordinary social events that are characterized as violent, that may also affect housing prices. Violence according to the World Health Organization is defined by “the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, which either results in or has a high likelihood of resulting in injury, death, psychological harm, mal-development, or deprivation” (WHO, 1996). Any social upheavals of a violent nature (with the characteristics just described) that take place locally, it is true that represent an adverse effect on the market of capital goods and property associated with the specific areas. The repercussions of violent social events may be physical damage, increased perceived risk and associated social stigma (Gourley, 2016). All these detrimental factors attributed to social unrest and the ensuing violence, shape people’s perceptions that finally affect consumer choices. It also true that the extend of the exact influence of each one of the above factors is quite difficult to be discerned clearly and quantified accordingly.

Western metropolitan cities like London and Paris have experienced extensive violent social events during the last decade. An important aspect of civil unrest is the impact on cities character, the spatial dynamics and the real estate trends. From a theoretical perspective, violence in general and crime have substantial impact on house prices, mainly based on people’s perception about the risks associated with investing in these areas. Indeed, it is empirically evident and rigorously tested that social unrest and

crime affect real estate and particularly property prices, if the phenomena are considered somehow endemic.

A study (of the very few) that has attempted to quantify and isolate the impact of riots on house prices it is the one by Collins and Smith (2006). With regard to the London riots case particularly, studies attempted to understand the political context and the social conditions that triggered the phenomenon and ways to tackle the social injustice and income inequalities (Rusbridger and Rees, 2011; Dockley, 2014). However, none of them tried to quantify the broader impact on the real estate sector, not even estimate the fundamental effects.

The riots in 2011 and the civil unrest that was spread out in London following the police shooting of Mark Duggan, represent an interesting event we chose to study and try to analyse the impact of civil disorder on house prices. The geography of London and the detailed data regarding its socio-economic composition, provide the appropriate information to study the spatial dynamics. In addition, it represents a city with a well-developed and transparent real estate market. It allows the researchers to have plethora data of transactions, facilitating a more in-depth analysis.

Furthermore, it was the first time in London's modern history, that riots of that extent happened. Lastly, the scale of the event under consideration had a considerable impact in people's perception about their security. The increasing frequency of civil unrest in the western prominent cities (as in Paris recently), renders the study of the impact that social disorder has on house prices and the broader spatial dynamics, a challenging exercise.

2. Literature Review

The degree to which violence in Northern Ireland has affected house prices and migration to areas with more secured peaceful future has been documented (Beasley *et al.*, 2012). The complexity of riots leaves no enough room to quite "comfortably" isolate and quantify the impact on house prices.

Collins and Smith (2006) attempted to estimate the impact of five riots during the period 1964-1971 on house prices in Cleveland. Their analysis extends from 1950 to 1980. The authors underline the weak fundamentals of the city during that period and clarify that the civil disorder was not the primary cause of the underperforming real estate sector. The plethora of malfunctions in Cleveland's economy, the decline of population and the changes in housing stock may endogenously bias the estimates and possibly overestimate riot's effect. In an attempt to address these issues the authors used two different techniques to increase the robustness of their results.

Firstly, ordinary least square method was deployed while they control for any pre-riot existing value trends and other relevant characteristics.

Secondly, matching techniques were used to compare the areas that were directly affected by the riots and the ones who were not.

Their analysis not only substantiates the causal impact of riots on property prices, but also demonstrates the exponential impact of their proximity. Analytically, depending on the estimation technique the findings indicated a property price decline in the city of Cleveland between 20%-30% in areas directly affected by the shock, compared to the ones who were not. More specifically properties which were located more than half a mile away from the epicentre of the disorder, had experienced value gains 7% than the ones at the epicentre. Further more, the ones located three miles away demonstrated 40% higher value gains compared to the ones at the centre.

Following up the previous research, Collins and Margo (2007) published an article aimed to narrow down their results. Their findings were focused on the value of black-owned properties and he applied both ordinary least square and two-stage least square techniques by exploiting exogenous variation. The results are in line with the expected decline in values caused by the disturbances and demonstrate no rebound after the events. The authors claim that the main reasons were attributed to the perception's change for local amenities and the deterioration in personal security, as well as the one concerning the entire community. In this context the significant decline in the prices of the colour owned properties, can be attributed to the vast population majorities of African Americans in the regions where riots took place. It is considered almost certain that "the results are consistent with a significant and persistent decline in relative demand for residence in the places where riots occurred", although the degradation of those areas had started before riots occurred (Collins *et al.*, 2007).

The current study can be placed in the general context of the causal relationship between social disorder violence, crimes and house prices. In that way, it is easier to understand the impact as part of the broader spectrum of violence that changes in the people's perception about risks associated with their security.

Lynch and Rasmussen (2001) conducted rigorous research on crime's effect on house prices in Florida. Their findings suggest that the measurements of crime so far, were not representative and did not contribute in understanding further the actual relationship between criminality and urban dynamics. Their analysis indicates that the seriousness of crimes rather than the number, is what causes spatial price differentials. In this framework, any research conducted up to that point provided a distorted picture of how people perceive their security and how they incorporate their perception into prices. Moreover, another result of the study is that crime's effect demonstrates discontinuity. Properties located in places with the highest cost of crime rate experienced 39% discounted prices compared with properties in other areas. On the other hand, the overall impact in location with relative low cost of crime rate was virtually negligible.

Gibbons (2003) in his article “Crime and property prices” gives another dimension of the spatial effects of crime. Counter to human intuition, his conclusions indicate that burglaries have no tangible effect on house prices. On the contrary, arson, vandalism and graffiti have tremendous impact on house prices, since degrade the property assets physically. An in-depth view can partially interpret this trend. People who plan to move into an area possibly do not have a clear picture of local crime rates (especially in case where these are not exceptionally high) but certainly perceive the general conditions and the destruction of the neighbourhood. Therefore, any evident degradation of the neighbourhood as it is manifested by vandalism has a direct impact on people’s willingness to pay for a property.

In accordance with the literature and consistent with its results is the research study by Braakmann (2017). The researcher used street level data from the British police in order to analyse the impact of three different types of crimes on property prices in England and Wales. The results indicate that house prices decline by 0.6–0.8% for every anti-social behaviour in the same street. An equivalent increase in violent crime leads to a decrease in prices by 0.6-1.6% whereas an equivalent raise in non-violent crime rates results in 0.2-0.4% decline of the house prices. Lastly, his findings confirm that property crimes have a negligible or positive impact on house prices. The author underlines that the latter finding is due to the weak identification strategy and the entailed endogeneity (reverse causality).

3. Methods of Analysis

3.1 Difference-in-Differences

One of the main econometric techniques is the Difference in Differences (DID) methodology. It is extensively used to isolate and estimate the impact of an exogenous shock or a policy on a characteristic of a group.

The technique assumes the existence of two similar ideally identical groups, control and treatment, from which the latter one has been affected by an exogenous shock. The critical underlined condition for the application of the DID methodology is that both these groups have experienced parallel trends before the aforementioned shock. In that case, any additional change in the trend of the observed characteristic of the intervention group in relation to the change in the trend of the observed characteristic of the control group, is attributed to the event that occurred (Columbia University, 2013).

3.1.1 Hedonic Regression in a DID Framework

The typical OLS model developed in a DID framework is the following:

$$Y = \beta_0 + \beta_1 * [\text{Time}] + \beta_2 * [\text{Treat}] + \beta_3 * [\text{Time} * \text{Treat}] + v_i \quad (1)$$

Where:

Y: variable of interest;

Treat dummy: equals one, in case the observation is from the treatment group;

Time dummy: equals one, in case the observation is after the exogenous shock;

Treat x Post dummy: equals one, in case the observation is from the treatment group and after the intervention;

β_3 is the coefficient of the intervention and it captures the unbiased effect of the intervention;

v_i is the error term.

Since it is desirable to verify that the two selected groups are similar, the main difficulty of the DID technique is to identify the appropriate control in relation to the selection of the treatment one. Apparently, it is impossible to claim that two different groups are identical in every aspect. However, slight differences are in align with the DID methodology, since the parallel trend assumption holds, and therefore it can be delivered without violation of the validity of the technique.

3.2 Geographical Reference

Any address in London can be specifically distinguished by its postcode. According to the Office for National Statistics (2018), postcodes are “alphanumeric references comprising an outward code of 2-4 characters and an inward code of three characters. Every postcode in the United Kingdom consists of 4 parts each of which corresponds to a specific geographical area. It is important to mention also that the postcode units get updated constantly based on the needs of the public service (Figure 1).

Figure 1. London postcode districts



Source: On the world map (2019).

Another geographical reference that is also used in the current study is the boroughs, that are marked in the following Figure 2.

Figure 2. The 33 London Boroughs

Source: On the world map (2019).

4. Data and Study Areas

4.1 Data

The data of the study have been obtained by HM Land Registry, which is the non-Ministerial department of the UK government responsible for the recording of any leases, mortgages and most importantly, any changes in the ownership of the vast majority of properties in England and Wales. It is the most credible source of data for English properties and one of the largest in Europe. It includes the actual transaction price, the date of transfer, the postcode of the property, its exact location (street, town/city, district, county) the property type (detached, semi-detached, terrace, flat / maisonette, other), the estate type (freehold / leasehold) and a unique identifier code to distinguish each property.

It is worthy to mention that the datasets obtained for the postcode districts of interest were not solely located in Southwark and Croydon boroughs. Postcode's geographical segregation is not always aligned entirely with the London's boroughs. Therefore, the same district might be part of more than one borough. In this case the datasets were modified to include the properties located solely in the boroughs of interest (different development and property policies implemented by the local authorities might lead to biased results). Moreover, Land Registry explicitly states that since a transaction takes place it takes approximately two weeks to two months to be recorded. Inherently, real estate is an asset that takes time to change hands and therefore, any transaction that happened after the riots does not necessarily reflect their impact. For these reasons, i.e. the delay in recording the transaction and the delay of the riot impact to be reflected in prices, it was decided to drop the data up to three months after the end of the civil disorder. Lastly, outliers (mostly units that were sold for multiple millions) that accounted for 1% were trimmed from the dataset.

4.2 Study Areas

Identifying the appropriate study areas was a crucial part of this research project. The validity of the DID method lies on the logit comparison of the control and treatment group. Therefore, a substantial part of the time was invested in choosing comparable areas that are naturally suitable for the application of the method (Figure 3).

Figure 3. Riot-related crimes in London



Source: Bell, Jaitman and Machin (2013).

Observing the above maps it is quite evident that the events were spread almost to the entire London territory. Ideally, the selected groups must have similar socio-economic and population characteristics. However, this similarity is not fundamental for the application of the method. In case these characteristics are relatively fixed, which probably are because districts change slowly relative to the period of analysis (short term analysis 2009-2014), then these differences between the two groups can explain difference in price levels, rather than differences in the evolution of the trends. However, it is useful to prove their similarities in case another shock (potentially unobserved) has affected part of the population in an area e.g. the black people. In this case if one of the groups has significantly larger portion of black people and the shock coincides with the riot shock then the variation will entirely be attributed to the riots. Fundamentally, this would bias the estimates and mislead the results.

Correspondingly, the areas under comparison should be located in the same borough. By studying areas located in the same administrative “unit” we aim to control for the different policies followed by the London borough councils which potentially affect the local development framework and therefore the property prices.

The social science literature that attempted to delve into the fundamental socio-economic reasons that trigger riots has been generally based on city level data. Though

scientific consistency implies that in the current study the same approach must be followed, this would drastically increase the endogeneity of the analysis. Various unobserved variables would increase the result's bias and would be misinterpreted as riot effect. Otherwise, the assumption implies that London experienced the same trends in all aspects across space. The size and the plethora of dynamics in a star city like London for instance the gentrification phenomenon, deviate spatially and this would fundamentally enhance the biasness and falsify the estimates of this study. In this context it was decided to use either postcode sectors or postcode districts. Initially, postcode sectors have been tested because similar studies estimate that the impact of criminal activities (not riot-related crimes) is inherently local. However, two issues arise with that geographical level of analysis.

Firstly, the transactions that take place in postcode sectors every quarter are not sufficient enough to produce statistically significant results. In this framework, postcode districts can offer larger number of transactions which can eventually deliver statistically significant results. Apart from the statistical perspective there is also another issue that favors the district-based analysis. When extensive shocks, like riots strike, then the reputation of a larger area, much broader than a typical postcode sector is tarnished. Subsequently, people's willingness to invest in a property is affected more by the news and the overall reputation of the area rather than the actual possibility of civil disorder and destruction in the neighbourhood of interest.

This approach is consistent with the research of Collins and Smith (2006). Though initially their analysis was conducted on neighbourhood level, their findings suggest that there is a negative riot coefficient almost with the same absolute value regardless the use of a narrow or broad riot tract. Fundamentally, the current research study must focus on postcode districts that were affected and destructed mostly by the 2011 riots.

4.2.1 Matching Maps to Postcodes

For the development of the DID analysis it is fundamental to match the above maps to specific locations and in that way, select the appropriate control and treatment group. Guardian covered in detail the social unrest and after the end of the violent events collected the verified incidents and provided analytic information about the time, the location and the type of the criminal action (loot, arson, windows destruction etc) (Rogers *et al.*, 2011).

The Guardian's dataset includes the violent incidents that took place all over England and therefore has been cleaned to focus exclusively in London. It is worth to mention that for some incidents the longitude and the latitude have been provided instead of the postcode reference. In these cases, the "Latitude Longitude" tool which is deployed for the conversion of geographical coordinates to addresses, has been used to identify and match the geographical points to the corresponding postcodes. The process of narrowing down the areas based on Guardian's postcode incidents pointed CR0 and SE17 postcode districts located in Croydon's and Southwark's boroughs accordingly.

4.3 Similarities and Parallel Trend Criteria

The fundamental assumption based on which every DiD econometric analysis is developed, is that the control and treatment group have experienced same trends before the strike of the riot shock. This condition is necessary in order to justify that any deviation that is observed during the post period can be attributed to effect of the treatment and not to the effect of another unidentified characteristic. In this way we can establish the causal impact of the shock to the variable of interest.

At this point it is essential to clarify that for the graphs presented in this research work the following abbreviations apply (Table 1):

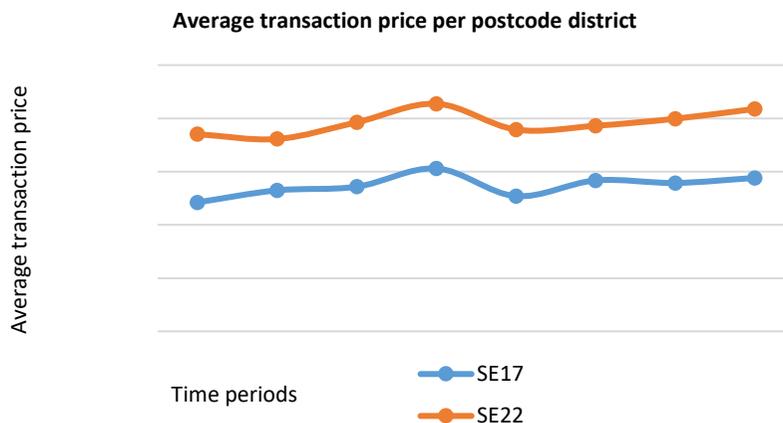
Table 1. Pre-treatment period quarters

Abbreviation	Corresponds to:
Q1	10 Aug 2009 – 9 Nov 2009
Q2	10 Nov 2009 – 9 Feb 2010
Q3	10 Feb 2010 – 9 May 2010
Q4	10 May 2010 – 9 Aug 2010
Q5	10 Aug 2010 – 9 Nov 2010
Q6	10 Nov 2010 – 9 Feb 2011
Q7	10 Feb 2011 – 9 May 2011
Q8	10 May 2011 – 9 Aug 2011

Source: Own study.

Indeed, the SE17 (treatment group, Southwark) and SE22 postcode districts demonstrated parallel property prices trends before the 2011 London riots. Figure 4 substantiates the similar price dynamics of the under-comparison areas.

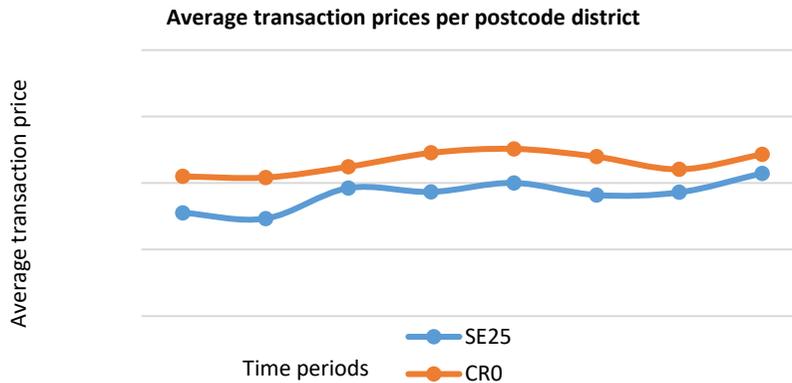
Figure 4. Average Transaction price for SE17, SE22 postcode districts, Aug 2009 – Aug 2011.



Source: Data obtained by the HM Land Registry¹²

Accordingly, postcode districts CR0, SE5 demonstrated similar price dynamics during the pre-riot period (Figure 5).

Figure 5. Average Transaction price for SE25, CR0 postcode districts Aug 2009 - Aug 2011



Source: Data obtained by the HM Land Registry¹

The above graphs illustrate the pre-riot period (2009 – 2011), which extends two years prior to the civil disorder. Apart from the parallel trends the above areas present similar socio-economic composition and therefore it is reasonable to develop the DID analysis.

4.3.1 Descriptive Statistics

Table 2 below demonstrates information for the socio-economic and racial composition as well as the property characteristics of the four districts for 2011, that establish the homogeneous nature of the districts exploited in DID analysis. The only source of concern is the more dynamic population of SE17 postcode district relative to the population composition of SE22 postcode district, which can potentially bias the results. The figures were calculated from the data available at the Nomis database which is provided by the Office for National Statistics. Accordingly, the household expenditures were estimated based on data available at the London's datastore which is provided by the Greater London Authority (GLA).

[1] HM Land Registry (2019) <http://landregistry.data.gov.uk/app/ppd/>

Table 2. Postcode districts' characteristics in 2011

	1 st Comparison		2 nd Comparison	
	SE25	CR0	SE22	SE17
Age clusters ¹				
0-17	26%	26%	20%	22%
18-24	9%	9%	7%	13%
25-29	8%	8%	10%	12%
30-44	25%	24%	33%	26%
45-59	20%	18%	18%	16%
60+	12%	15%	12%	11%
Employment per ethnic group ¹				
White	91.3%	92.3%	95.7%	91.6%
Black	84.4%	85.1%	84.9%	80.5%
Asian	89.7%	91.6%	93.5%	86.5%
Mixed	81.2%	84.8%	87.5%	83.8%
Religion ¹				
Christians	61%	55%	49%	55%
Muslims	7%	8%	4%	12%
Other religion	4%	8%	2%	3%
No religion	20%	21%	35%	22%
Housing stock composition ¹				
Households with central heating	95.8%	97.1%	97%	96.7%
Average people per household	2.3	2.5	2.3	2.4
Average rooms per household	4.5	4.8	4.6	4.0
Average bedrooms per household	2.3	2.4	2.4	2.1
% of Total Household Expenditure ²				
Convenience Goods	12%	11%	10%	12%
Bulky Goods	6%	7%	6%	6%
Not Bulky Goods	13%	12%	11%	10%
Restaurants/ Pubs / Take-away	6%	7%	7%	6%
Leisure	3%	3%	3%	3%
Health/ Education	49%	48%	52%	52%
Other goods and services	11%	12%	11%	9%

Sources: [1] Nomis Database (2014), [2] London Datastore (2013).

The following Table 3 demonstrates characteristics regarding the properties located at the areas of interest. Despite the major differences observed, these dissimilarities do not bias the findings since they have been incorporated in the models. However, this heterogeneity may reflect other unobserved differences between the areas, which can potentially bias the results.

It is worth mentioning that one of the major components that characterises the overall composition of an area is the average income. The Office for National Statistics does not publish data regarding the income at a postcode districts level. The only data related to the income of people is structured on local authority level, which does not serve the aim of the current study.

Table 3. Property characteristics

	1 st Comparison		2 nd Comparison	
	SE17	SE22	CR0	SE25
Property type				
Detached	0.4%	1.1%	5.3%	1.7%
Semi-detached	1.0%	11.2%	18.3%	9.5%
Terraced	15.8%	35.6%	44.3%	47.5%
Flat/Maisonette	82.4%	51.8%	31.9%	40.9%
Other	0.4%	0.3%	0.2%	0.3%
New built?				
New	83.7%	98.1%	85.8%	90.0%
Old	16.3%	1.9%	14.2%	10.0%
Estate type				
Freehold	17.1%	47.0%	54.6%	48.0%
Leasehold	82.9%	53.0%	45.4%	52.0%

Source: Office for National Statistics (2019).

5. Empirical Analysis

5.1 Econometric Specification

The OLS model applied for the specification of the DID estimator was constructed, based on available characteristics of properties at the Land Registry database. Additionally, the model incorporates quarterly time fixed effects and district fixed effects in order to control for the price trends attributed to the post-crisis period and the unobserved heterogeneity between the under-comparison areas. Lastly, the typical interaction dummy is replaced by two dummies representing the impact of different periods. The first dummy corresponds to the first year after the riots whereas the second interaction dummy corresponds to the impact of the second and the third year after the riots. The deployment of these dummies will contribute to understand not only the level of the effect, but also the variation of the impact and its time horizon.

The model used has the following structure:

$$\ln(\text{Pit}) = \alpha + \beta_1 * \text{property} + \beta_2 * \text{estate} + \beta_3 * \text{new} + \beta_4 * \text{treat} + \beta_5 * i.\text{quarter_Year} + \beta_6 * \text{short_term} + \beta_7 * \text{long_term} + \varepsilon_{it}$$

Where:

$\ln(\text{Pit})$: natural logarithm of property sales price for postcode i in a given period t ;

α : constant;

property : control variable for the different types of properties, equals 1 for detached properties, 2 for semi-detached properties, 3 for flats/maisonettes, 4 for terraced, 5 for other types of property;

estate : dummy variable, equals 0 for freehold property, 1 for leasehold;

new : dummy variable, equals 0 for old building, 1 for new;

treat : dummy equals 0 for control area (SE22, SE25), 1 for treatment area (SE17, CR0);

i.quarter: dummy variable indicating the quarter during which the transaction took place;

short_term: Interaction dummy equals 1 if the transaction is at the treatment area and during the first year after the end of riots, otherwise 0;

long_term: Interaction dummy equals 1 if the transaction is at the treatment area and during the first year after the end of riots, otherwise 0.

Though three-year horizon is not considered long term for real estate investments the term has been used for the better understanding of the study.

The theoretical assumption made in this study is that riots will have a short to medium term impact on property prices. Therefore, the period of analysis extends up to three years after the shock and does not continue further on. The strong fundamentals of London real estate market such as the supply constraints due to horizontal (Green belt), the vertical restrictions (height restrictions) and the highly regulated environment in conjunction with the diachronic demand and the gentrification phenomenon, would eliminate any negative shock on property prices.

Moreover, the turmoil in the global economy and the institutional and political instability of other countries affect primarily London's real estate market probably more than any other. Specifically, many studies and reports demonstrate that London house prices are partly linked to the local dynamics. For example, during 2014-2015 London has experienced a boost in property prices partly because of the riots in Egypt and the Greece's recession and later its referendum to leave the Eurozone (Karaian, 2014).

Lastly, but most importantly, an additional reason for which the period is constrained is the general economic impact of Brexit and its implications on the real estate market, which could not be controlled for. In that framework, the impact would be a multi-dimensional, poly-parametric and it would be much difficult to isolate the causal effect of London riots to house prices.

5.2 Results

Applying the aforementioned model after the modifications regarding the interaction dummy, we get consistent results for both comparisons as shown below. Analytically for the District Comparison SE17 vs SE22, Southwark Borough (Table 4):

Table 4. OLS Estimates SE17 vs SE22
Dependant variable: Ln (P)

	Model I	Model II
Property type	-	-.079***(.0112)
New	-	.135***(.0249)
Estate type	-	-.724***(.0124)
Treat	-.344***(.0245)	-.149***(.0186)
1st year Interaction	-.054(0.0478)	-.041(.0357)
2nd & 3rd year interaction	-.032(0.0332)	-.050**(.0252)
Quarterly time fixed effects	YES	YES
Constant	12.706***(.0339)	13.292***(.0443)
Observations	3,564	3,564
R ²	0.165	0.612

Source: Own study.

The dependant variable is the Ln of property price in both models. The *property type* variable is equal to 1 for detached properties, 2 for semi-detached, 3 for flat / maisonette, 4 for terraced and 5 for other type. *New* dummy is 0 for old properties and 1 for new built properties. *Estate type* dummy equals 0 for freehold property, otherwise 1. *Treat* dummy is 0 for transaction in SE22 postcode district and 1 for SE17 postcode district. The *1st year interaction* dummy is 1 for transaction happened within one year after the end of the riots at the SE17 postcode districts, otherwise 0. Accordingly, *2nd & 3rd year interaction* dummy is 1 for transaction happened during the second and third year after the end of the riots at the SE17 postcode district, otherwise 0. The observation period ranges from two years before to three years after the end of the riots. Standard errors in parenthesis. *p < 0.10, **p < 0.05, ***p < 0.01

The District Comparison CR0 vs SE25, Southwark Borough is shown in Table 5:

Table 5. OLS Estimates, CR0 vs SE25
Dependant variable: Ln (P)

	Model III	Model IV
Property type	-	-.136***(.0039)
New	-	.215***(.0082)
Estate type	-	-.482***(.0063)
Treat	.114***(.0163)	.068***(.0117)
1st year Interaction	.003(.0307)	-.014(.0220)
2nd & 3rd year interaction	-.037*(.0201)	-.048***(.0145)
Quarterly time fixed effects	YES	YES
Constant	12.036***(.0210)	12.700***(.0207)
Observations	9,934	9,934
R ²	0.053	0.474

Source: Own study.

Notes: The dependant variable is the Ln of property price in both models. The **property type** variable is equal to 1 for detached properties, 2 for semi-detached, 3 for flat / maisonette, 4 for terraced and 5 for other type. **New** dummy is 0 for old properties and 1 for new built properties. **Estate type** dummy equals 0 for freehold property, otherwise 1. **Treat** dummy is 0 for transaction in SE25 postcode district and 1 for CR0 postcode district. The **1st year interaction** dummy is 1 for transaction happened within one year after the end of the riots at the CR0 postcode districts, otherwise 0. Accordingly, **2nd & 3rd year interaction** dummy is 1 for transaction happened during the second and third year after the end of the riots at the CR0 postcode district, otherwise 0. The observation period ranges from two years before to three years after the end of the riots. Standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The two comparisons indicate almost identical effect in both cases. This consistency enhances the credibility of the results. Analytically, the social unrest appears to have statistically insignificant impact on house prices during the first year after the end of the shock. Therefore, no solid conclusion can be extracted regarding the very short-term horizon of riot's effect. On the other hand, based on the statistical analysis, house prices declined 4,8% and 5% in CR0 and SE17 postcode districts accordingly.

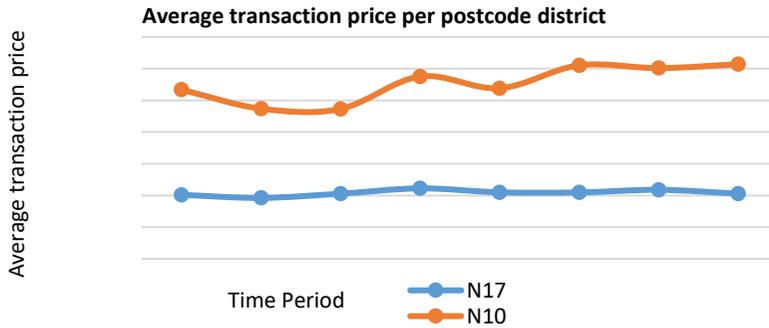
The marginal difference between the two coefficients and the high R^2 of the models presented, demonstrate the quality of the results and the explanatory power of the analysis. However, according to Census 2011 the treatment group in Croydon, CR0 district, is much larger in terms of both land and populations than the one in Southwark borough (SE17). In that regard, in our dataset might have been included transactions that were not affected by the riots making the overall impact less in magnitude.

There is also another concern relative to the endogenous nature of the current study. The observation period of 5 years is large enough to assume that no other shock happened that affected the results. In this case, the aforementioned variation might have been attributed to the interaction dummies and therefore to the riots which fundamentally produces biased results. For that reason, further steps have been chosen to ensure that the coefficients are not a product of a local unobserved shock, that coincidental to the civil disorder in the selected groups.

5.3 Further Analysis

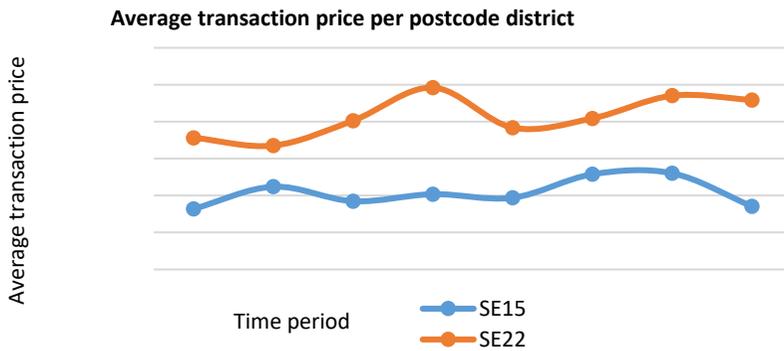
For the establishment of the results and the enhancement of the analysis credibility, further attempts to apply the DID methodology have been conducted. Specifically, the parallel trend condition has been tested for almost the entire London's boroughs at which riot-related incidents have taken place. Briefly, the below graphs summarize the price trends in the districts that were analysed. Specifically, postcode districts located in Haringey, Merton, Ealing, Lewisham Lambeth and in Peckham, did not fulfil the condition and therefore were not considered suitable.

Figure 6. Average Transaction price for N17, N10 postcode districts Aug 2009 - Aug 2011



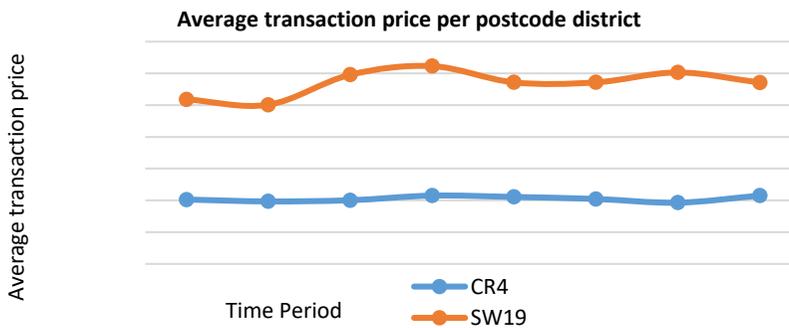
Source: Data obtained by the HM Land Registry¹²

Figure 7. Average Transaction price for SE15, SE22 (Peckham) postcode districts Aug 2009 – Aug 2011.



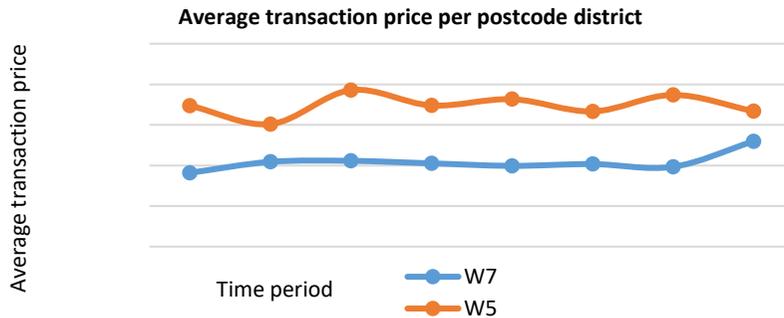
Source: Data obtained by the HM Land Registry¹²

Figure 8. Average Transaction price for CR4, SW19 (Merton Borough) postcode districts Aug 2009 – Aug 2011



Source: Data obtained by the HM Land Registry¹²

Figure 9. Average Transaction price for W7, W5 (Ealing Borough) postcode districts Aug 2009 – Aug 2011.



Source: Data obtained by the HM Land Registry¹²

5.4 Limitations and Critique

According to Bell *et al.* (2013) non riot crimes increased after the civil unrest. After the civil disorder the authorities imposed tougher sentences to riot-related crimes which deterred criminals and led them to commit other types of crimes. In this framework, since non-riot crimes have increased after the disorder this can potentially bias the results and demonstrate a significantly larger impact (price decline) attributed to the shock. On the other hand, the reduction of riot-related crimes can lead to an increase in house prices. The impact of this trade-off must be quantified. In the same framework can be placed any location-specific shock that affects positively or negatively house prices and coincides with the 2011 riots. For these reasons we remain reserved regarding the interpretation of the findings and their validity.

Moreover, the model presented does not take under account any differences in the properties sold throughout the period and space. Apart from the property type (detached, semi-detached etc) the age (new/old) and the estate status (freehold / leasehold) which have been ruled out, energy efficiency and structural characteristics affect house prices. Though we presented the similar house composition of the postcode districts and therefore substantiated their comparability this does not necessarily mean that the properties that changed hands had similar characteristics. In that regard, the identification strategy that has been followed might produce biased results.

In addition and most importantly, it is vital to rule out the population dynamics and trends. Especially in case of London where prices are mostly determined by the demand observed, since supply is consecutively constrained, it is even more important to control for the population changes. The difficulty in incorporating the population's impact on house price is related to the data availability. Census survey is conducted every ten years which does not allow us to understand fully the changes across time. Any projection would be somewhat arbitrary and would not increase the explanatory power of the model.

The results are not consistent with the only research work, that attempted to isolate the causal impact of riots on house prices. Collins *et al.* (2006) find a long-term considerable impact on house prices which accounts to approximately 20%-30% decline. This estimation varies according to the estimation technique and the regression specifications. Additionally, according to their results the prices did not rebound after the riots.

However, they underline the weak fundamentals of Cleveland's economic performance and denote that during general economic decline an unexpected negative event can lead to disproportionate decline in property prices (Glaeser and Gyourko, 2005). Therefore, they acknowledge that their findings might be larger than what they normally should because of capturing other components. Lastly, their findings can be interpreted based on the frequency of the shock, which in the specific case happened five times in seven years. Therefore, in people's perception the risks associated with riots had potentially permanently rooted characteristics, and not en ephemeral ones.

London on the other hand, represents almost an exactly opposite case. Prices are relative stable and regardless the general economic environment or potential temporary negative shocks they, traditionally maintain their positive prospects. The thriving economy, the business-oriented growth and the strong fundamentals of London (foreign investments, gentrification etc) secure its viability and many times immunize its property market against economic decline, at least up to Brexit tipping point.

Additionally, Cleveland experienced five different riot events in seven years whereas London experienced one. Subsequently, it was perceived as a one-time event and not a factor of neighbourhood quality deterioration or something that will affect the future price growth. For all these reasons prices have recovered at the pre-riot levels within few months, though we still do not know the entirely the horizon of the effect.

All the above arguments demonstrate, that essentially the two studies do not contradict since the characteristics of the two cities are utterly different. Urban economies react, adjust and absorb price shocks differently based on their characteristics, the magnitude, the frequency as well as the spatial fundamentals. Any local quality deterioration is being perceived distinctively and must be studied accordingly as such. Price differentials in the urban environment is a complex phenomenon and the outcome of multiple parameters and conditions.

The findings of this research are not necessarily valid for other cities or applied to other riot cases since:

- 1) every shock has its own characteristics and affects the spatial dynamics distinctively across time.

- 2) Urban economies react and absorb price shocks differently based on their characteristics, the magnitude, the frequency as well as the spatial fundamentals.

Concerns are raised about the general conditions in parts of London that have not recovered from the crisis. Concerns were confirmed one year later in Dalston where riots started over the death of Rashan Charles.

For all the above, this study has a much broader aim than just quantifying the impact on property prices. It was conducted to trigger further research on this topic which has remained unexplored despite its exceptional scientific interest. Riots combine the economic impact and the social theoretical background. In that regard, understanding their impact on property prices, the policy makers can better estimate how urban economies interact with population, absorb localized ephemeral events, that are not as persistent as general crime. In that sense, it is possible to shape a balanced and harmonic urban environment.

Besides the public authorities this study can also be useful to real estate investors especially if it gets extended to identify the period it takes for the riot's effect to subside. Given the existing strong fundamentals of London's real estate market, there are very few opportunities to take advantage of. In that regard, investors can identify these negative shocks, exploit the price decline and make relatively safe profits by waiting the negative impact to subside. The vertical and horizontal restrictions and the strict regulatory environment (NIMBYS, high local authorities' refusal rates) fundamentally lead to resilient growth on property price. In that sense, any short-term negative shock that can cause any deviations from the long-term trend can be exploited for potential gains.

6. Conclusion

This research study is the only attempt to quantify the impact of recent riots on property prices. The particularities of London and of 2011 riots which had unprecedented effect in the capital's history distinguish this case study. This research study is an attempt to quantify the impact of riots on property prices. The findings suggest that after the 2011 London riots, property prices in London have dropped approximately 5% in the areas affected. The duration of the effect has not been determined however, it seems that the impact was not very short term though intuitively we expected the opposite. At least three years after the end of the civil disorder prices were still reflecting people's perception regarding the risk associated with investing in these areas.

The findings must be interpreted with the necessary caution though, since they are not necessarily valid for other cities or cases, since every shock has its own distinct characteristics and doesn't affect the spatial dynamics in a uniform fashion across time.

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