The Fine Scale Spatial Dynamics of the Greater London Housing Market

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1. Introduction

This paper outlines our current research exploring the fine scale spatial dynamics of the Greater London housing market. Residential property modelling has many applications for informing planning policy from understanding local housing submarkets through to being used as a proxy for measuring the impact of public investment (for example on transport improvements) within specific areas.

In the London context, population and economic growth have created acute pressures on housing. London's population is projected to increase by around 1.14 million to 8.71 million by 2026 (GLA, 2006a) whilst employment is projected to increase by 912,000 jobs between 2006 and 2026 (GLA Economics, 2007). The Further Alterations to the London Plan has set targets of building over 30,000 new homes per year to address this increase in demand. To meet sustainable development and regeneration aims growth is being directed to Inner and East London (Figure 1), with high density development concentrated at areas with good public transport accessibility (see GLA 2004, 2006b for further information).

One established method for the spatial modelling of the housing market is the hedonic approach, where house prices are considered to be a capitalisation of the stream of services provided by the property (Gibbons et al, 2005). These services include internal facilities such as shelter and heating as well as the external opportunities of location, such as access to amenities, jobs and education.

Influences on house prices vary depending on the scale of analysis. For example the expanding jobs market in the South East is driving housing demand at the broader scale and has produced record prices across the entire region. There are also influential factors at very localised scales. For example, the quality of the housing stock can vary widely at small spatial scales in London, and has so far been difficult to model due to a lack of data (Atisreal, 2005). Environmental amenity is also highly valued in the housing market and varies at local scales.

This research will explore the influence of these fine scale factors on the housing market. At present the research is work in progress and the model is under development. The remainder of this paper will discuss our initial research steps.

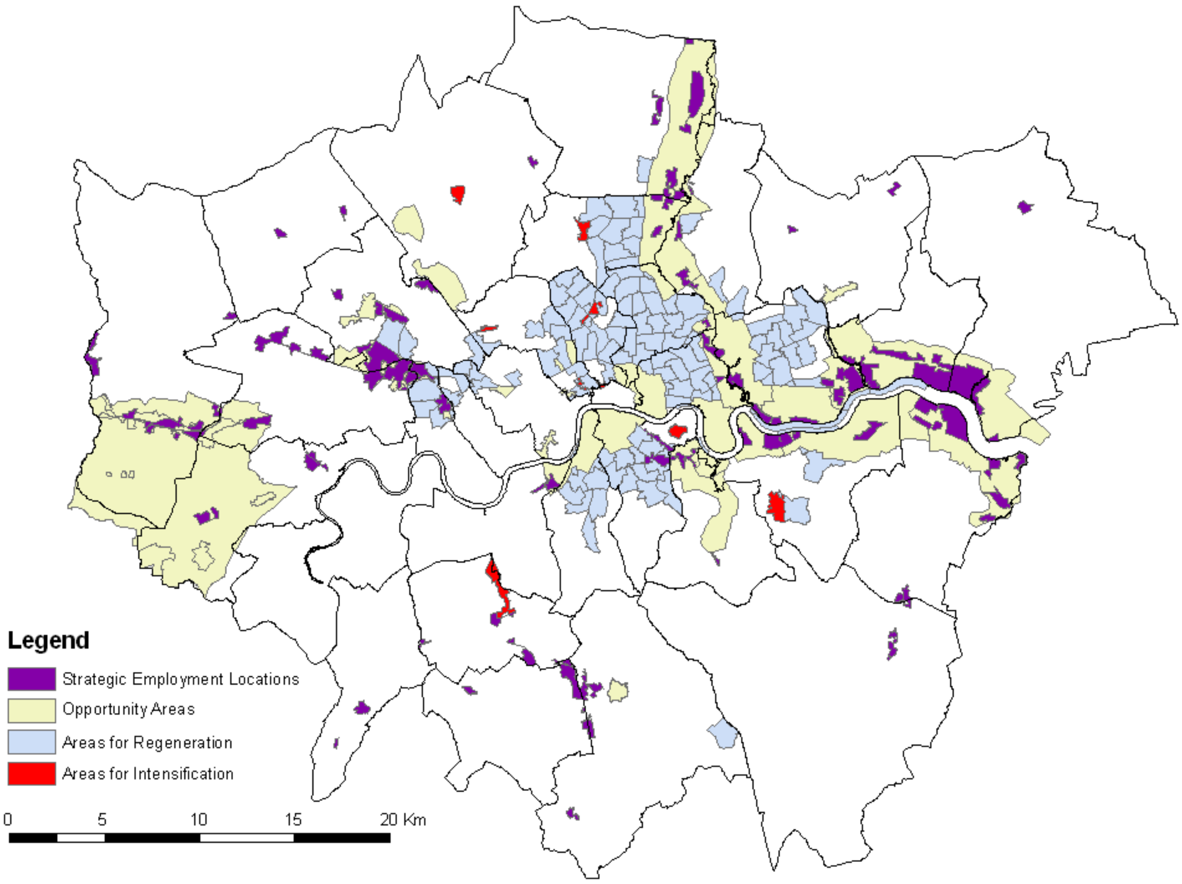

Figure 1. Areas designated for change within the London Plan

2. Methodology

In this research we are aiming to model the most significant influences on the housing market at fine spatial scales. Significant factors identified in recent research (Atisreal, 2005) include:

- Housing quality
- Access to services (jobs, education, local amenities)
- Public transport accessibility
- Crime and deprivation
- Environmental quality

This is in addition to macroeconomic and monetary policy set at a national level, and local taxation.

Within this research we utilise a 3-D GIS/CAD model of London, referred to as Virtual London (Batty and Hudson-Smith, 2005). This is a digital model of all building blocks within Greater London. The dataset has been created from two main sources of data: first vector parcel files part of Ordnance Survey's MasterMap[1] which code all land parcels and streets to at least one meter accuracy; and second a data set of buildings heights constructed from InfoTerra's[2] LIDAR data.. MasterMap's Address Layer 2[3] can be used to link the Virtual London data at building level to any data set with postal addresses. The Virtual London dataset will be used to calculate a number of indicators relevant to housing quality (density, private garden space and social housing proportion)

[1] http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/
[2] http://www.infoterra.co.uk/
[3] http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/layers/addresslayer2/

and environmental quality (access to public green space, quality of views using building heights and proximity to environmental features such as the Thames).

Combined with the above model we utilise CACI's PayCheck[4] dataset for gross household income and CACI's StreetValue[5] dataset for residential property price, both at the postcode unit level to extrapolate average house price and income. Data is further extracted from the census, Land Registry (e.g. the number and date of sales, the price, the type of property and whether or not it is a new build) and the Greater London Authority (GLA) (e.g. Public transport accessibility levels, population catchments by public transport within 45 generalised minutes[6]). These datasets, once combined provide a unique fine scale information of London giving more accurate modelling options for specific locations.

3. First Steps/Preliminary Results

As this is work in progress it is felt more appropriate to highlight how the above datasets provide us with an understanding of the London housing market. Further analysis is needed before any broad conclusions can be made. For this reason we will focus one some aggregate analysis before focusing on one area of London, that of East London's Docklands.

Simple aggregate analysis of tells us little about the London housing market. For example, the mean house-price when the data was cleaned to remove postcodes with zero population within London is £326,701 with a standard deviation of £229,779. Table 1 clearly demonstrates that comparing residential property prices against selected variables highlights that there is great variation within London. This is further supported when trying to compare one variable against house prices using a linear regression, low R^2 values are seen a for all independent variables apart from household income. This suggests there is much geographical variation as shown in the GLA's 'London's Housing Submarkets' report (GLA Economics, 2004) and more specialist analysis is needed (which we are currently working on). For this reason we are focusing on the fine scale analysis of selected areas. This is to which we now turn.

Table 1. Summary statics of house prices at the unit postcode in London against a selection of variables

Test		Household income (£)	Public transport accessibility levels	Population catchments by public transport within 45 min	Straight Line Distance (m) to Place of Education (School)				Straight Line Distance to Tube Station (m)	Straight Line Distance to Train Station (m)	Straight Line Distance A Road (m)	Straight Line Distance to River (m)
					Nearest school of any type	Nursery	Primary	Secondary				
Mean		39265	4.72	1309585	249	2637	378	838	2372	972	290	5878
Stand Deviation		10370	2.03	748351	169	2447	234	456	2843	641	311	4491
R^2		0.201	0.026	0.042	0.002	0.002	0.019	0.005	0.018	0.005	0.001	0.006
Coefficients	Value	9.93	18306.75	0.06	61.56	-4.19	135.69	34.35	-10.87	25.32	-16.78	-3.93
	Std. Error	0.05	293.67	0.00	3.58	0.25	2.56	1.32	0.21	0.94	1.94	0.13
T Value		190.76	62.34	79.83	17.21	-17.00	53.09	26.02	-51.67	26.95	-8.63	-29.35

The Docklands has been the setting for dramatic urban change over the last 25 years, with large scale market led redevelopment of industrial land creating localised clusters of new housing and resulting in sharp social contrasts. Figure 2 illustrates the distribution of house prices in 2007. High price areas appear to cling to the river, due to new upmarket high density apartment developments at waterfront locations, such as Shadwell and Limehouse (the historic upmarket residential location of Greenwich

[4] http://www.caci.co.uk/msd.asp?url=cm-data-paycheck.htm
[5] http://www.caci.co.uk/msd.asp?url=cm-data-streetvalue.htm
[6] Generalised time is the total time spent on a journey, weighted to account for traveller preferences.

is also visible, whilst new housing developments at Greenwich Peninsula are not yet complete). Clearly data on new build housing and the value of river views will be significant in modelling property market changes in this area.

Inland from the Thames are areas of much larger social housing estates, such as Peckham and Poplar, which fall into the lowest band of house prices. The new waterfront developments are often adjacent to smaller areas of 1960s and 1970s social housing, as for example on the Isle of Dogs where the social housing appears as small clusters of lower than average prices. Figure 3 shows this in detail, with upmarket new build along the waterfront and social housing tower-blocks behind. Both housing types can be at high densities, implying that relationships between density and price are dependent on the context of housing age and quality.

Market trends towards luxury waterfront housing risk exacerbating social polarisation in Docklands. To minimise social division the 2004 London Plan (GLA 2004) has set the target of a 50% proportion of affordable housing in new developments.

There is no clear relationship between house prices and proximity to public transport interchanges. Research provides evidence of the influence of public transport accessibility on house prices within a kilometre of interchanges (Gibbons and Machin, 2005) but this is by itself not a sufficient condition for higher priced housing (Figure 2).

Figure 2. East London / Docklands House Price Surface Map.

Source: CACI StreetValue data.

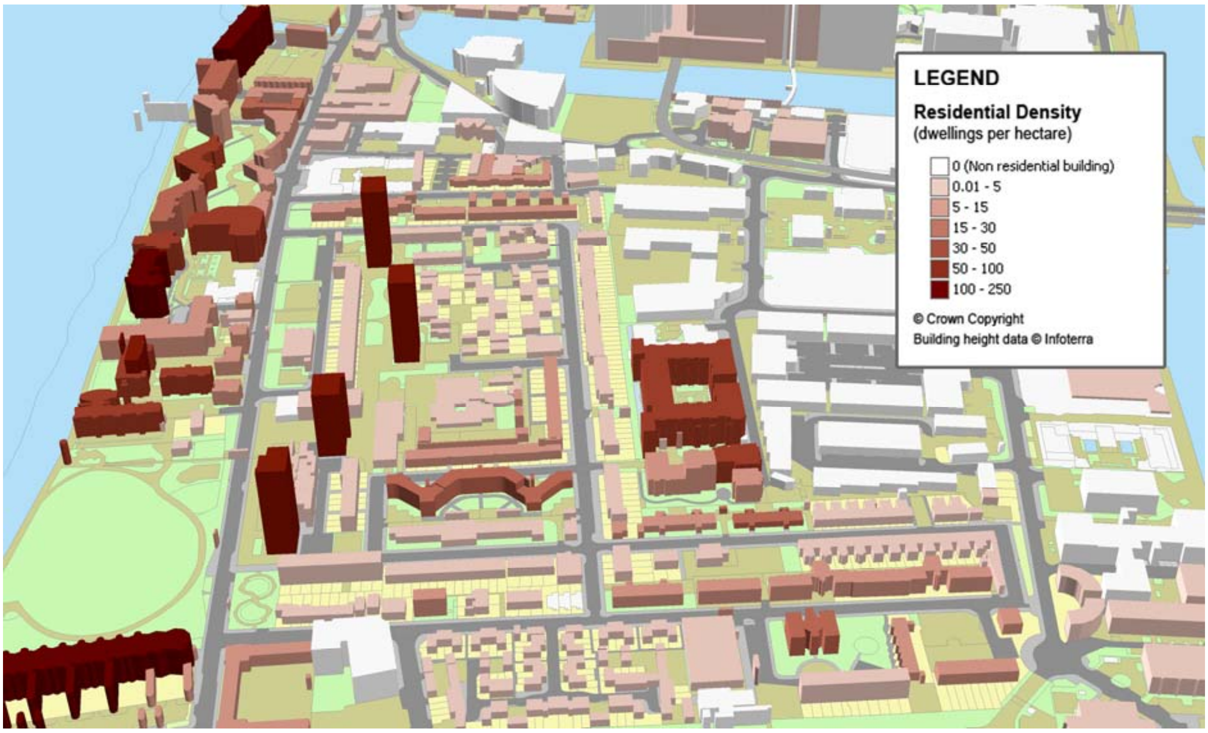

Figure 3. Isle of Dogs Housing Density 3D Map.

Source: Virtual London.

4. Further Work

Fine resolution data, potentially allows us to create models exploring the small scale dynamics of the London housing market from the individual perspective thus furthering our understanding of this complex issue. Agent-based modelling (ABM) is inherently suited to such a study as it allows the representation of an heterogeneous population with individual agents having different behaviours and characteristics. These agents interact locally to form more complex aggregate patterns. Some recent examples of such housing models include Bossomaier *et al.* (2007), Torrens (2007) and Torrens and Nara (2007). There is also a growing interest in combining ABM and GIS (see Castle and Crooks, 2007). However many of the ABM applications currently utilising geospatial data do so using a cellular space representation of reality which involves populating regular cellular space with agents of one or several kinds which can migrate between cells. While agent-based models created using the cellular partition of space have provided valuable insights into urban phenomena especially as they can capture geographic detail, they miss geometric detail. This area is critical to good applications but is barely touched upon in the literature (Batty, 2005) with a few exceptions, (e.g. Benenson *et al.*, 2002). The ability to represent the world as a series of points, lines and polygons allows the inclusion of geometry into the modelling process, therefore allowing for different sizes of features such as houses, roads and so on to be portrayed. This is currently being achieved through the utilisation of the data sets described above. For example, using MasterMap TOIDS (Topographic Identifier) to represent individual buildings; MasterMap's Address layer to populate these building with a number of units and assigning individual agents to each of these units.

A prototype model is currently being developed focusing on residential location and dynamics within London (Figure 4). This model is loosely coupled with GIS and explores vendor/buyer behaviour whereby the agent's decisions/behaviour of where to locate is affected by spatial attributes of actual land-parcels.

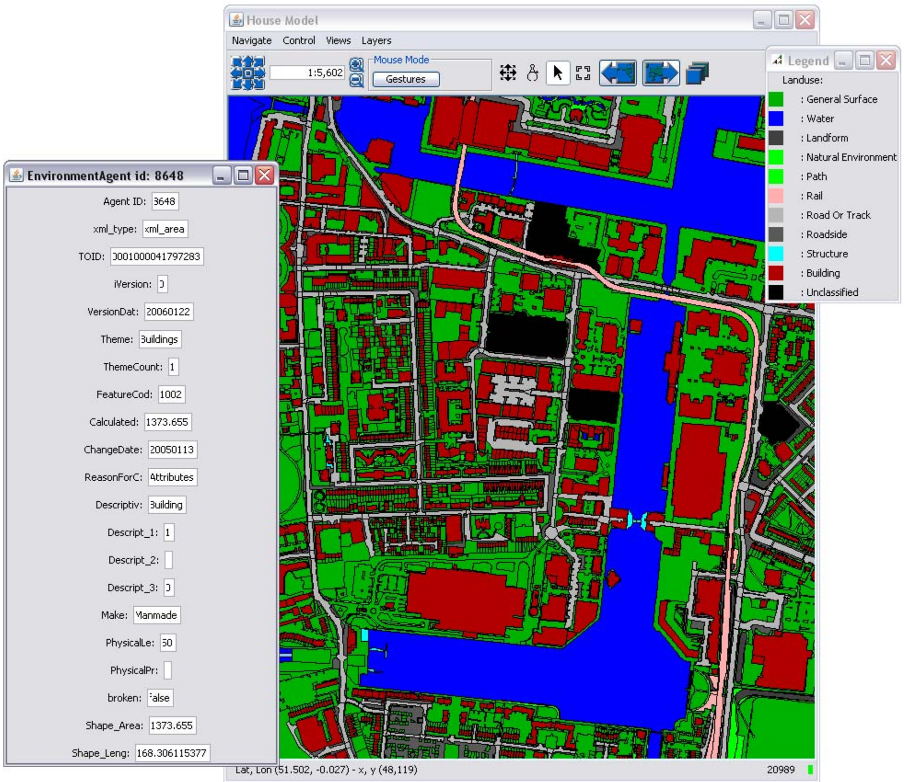

Figure 4. Prototype agent-based model (showing the built environment dimensioned to the geography of the Isle of Dogs, Tower Hamlets). ©Crown Copyright.

5. Conclusion

This paper has outlined how we are building up a detailed understanding of the Greater London housing market. To enhance this understanding three avenues of research are being explored. The first is building a comprehensive dataset of the London housing market. Access to temporal datasets such as sales data at the individual level is key to this research and we are currently acquiring such a dataset. This potentially allows to the quantification of the impact of infrastructure in certain locations (e.g. Gibbons and Machin 2005; Atisreal, 2005). Furthermore, detailed information about who lives in places, for example information from the Electoral Role is needed. This will lead to a detailed picture of the social class and ethnicity of areas (Mateos 2007). Secondly several advanced spatial analysis techniques, for example, geographical weighted regression (Fotheringham *et al.*, 2002) are being applied to the data. Thirdly, the development of an agent-based model which allows us to model residential locational decisions with agents rules loosely based on information from the data analysis. It is anticipated that these combined approaches will lead to a greater understanding of the London Housing Market for informing policy options by the GLA.

6. Acknowledgements

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Biography

Andrew Crooks is a GLA Economics Research Fellow in Urban Systems at the Centre for Advanced Spatial Analysis (CASA) at UCL. He has recently completed a PhD entitled "Experimenting with Cities: Utilizing Agent-Based Models and GIS to Explore Urban Dynamics." His research interests are structured around issues effecting world cities specifically focusing on London.

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