A Multi-scale Spatio-temporal Approach to Analysing the changing inequality in the Housing Market during 2001-2014

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Abstract

The spatial inequality in house prices between the UK regions has been extensively researched in the existing literature, but the analysis at a sub-regional level is scarce. This working paper presents an integrated spatio-temporal approach that allows for the examination of the changing inequality in house prices at multiple spatial scales and over time simultaneously. By utilising a large-scale non-aggregated spatial housing dataset in England during 2001-2014, this study provides the most thorough and systematic spatiotemporal analysis of the changing patterns in house prices in England.

1998 ACM Subject Classification I.5.2 Design Methodology

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1   Background

The spatial inequality in house prices between the UK regions is usually characterised as the North-South divide – lower in the former, higher in the latter [1-3]. This gap emerged in the 1970s, widened in the 1980s, and then somewhat reversed in the early 1990s. Until then, the regional house price movements were approximately aligned with national house prices [4-5], but since the mid-1990s some sub-housing markets in the country have become 'de-coupled' from the national market [6].

Apart from the wide regional price disparities, substantial price variations also started to emerge within regions[7]. The existing literature on the house price variation, however, commonly analysed the patterns cross-sectionally at one spatial scale at regional level, or temporal trends at national level. Spatio-temporal patterns were commonly analysed by applying the same cross-sectional methodology repeatedly at different time points.

The purpose of this study is to develop a new multi-scale spatio-temporal approach that allows the consideration of varying temporal trends at multiple geographic scales and thus to offer a thorough and systematic analysis of the changing patterns in house price differentials between and within regions at multiple spatial scales for entire England.

2   Data and Methodology

A complete list of historical house transactions (13.6 million) in England during 2001-2014 was obtained from the Land Registry of England and Wales. Multiple spatial scales were investigated: region, Local Authority District (LAD), Middle- and lower-Super Output Areas (MSOA and LSOA), and Output Areas(OAs). MSOAs, LSOAs and OAs are the UK census geographies, which were designed to be socially homogeneous in terms of household numbers, housing type and tenure.

An integrated model-based spatio-temporal approach was developed to investigate the changing patterns at multiple scales over time. First, a fixed-effects approach[8] is employed to examine housing price inequality at the regional level. Regions were modelled as having fixed effects on house price by using dummy indicator representing each English region. A five-level random-effects model incorporating varying temporal effects across multiple-scale geographical areas were then developed to examine the changing geographical variations at sub-regional level over time.

The sub-regional units under investigation have a strictly hierarchical structure, where houses were nested within OAs, which, in turn were nested within LSOAs, MSOAs, and then LADs. These units were specified as having random effects through a five-level random-effects model with the level 1-5 units being houses, OAs, LSOAs, MSOAs and LADs, respectively. The stochastic variations between houses at level-1 as well as the spatial variations at sub-regional levels net of other levels and after removing regional differences can be examined simultaneously through this modelling technique.

The potentially different temporal trajectories of places are explored by allowing the effects of time to vary across space. This is achieved by allowing the coefficient of time variables to vary randomly across the units at all five scales. This approach not only allows the identification of the most marked spatial scale that accounts for price variation but also allows the changing patterns of spatial variations in house prices to be modelled as a function of time.

This spatio-temporal approach allows the investigation of temporal trends at each spatial level and spatial variations of house price at multiple scales simultaneously. It also produces more precise and robust estimations, which are shrunken towards the overall mean of the next higher-level units[9].

3   Results

3.1   Trends in Regional Housing Markets

Substantial price differentials were found between the nine English regions. The variations in the aggregated average house price between regions were three-fold in January 2001, dropped to 2.6-fold in January 2008 and rose to four-fold in Dec 2014. The modelled mean house prices at the regional level were presented in Figure 1. London was found to have seen major and extensive increases over the period and pulled away from the rest of English regions.
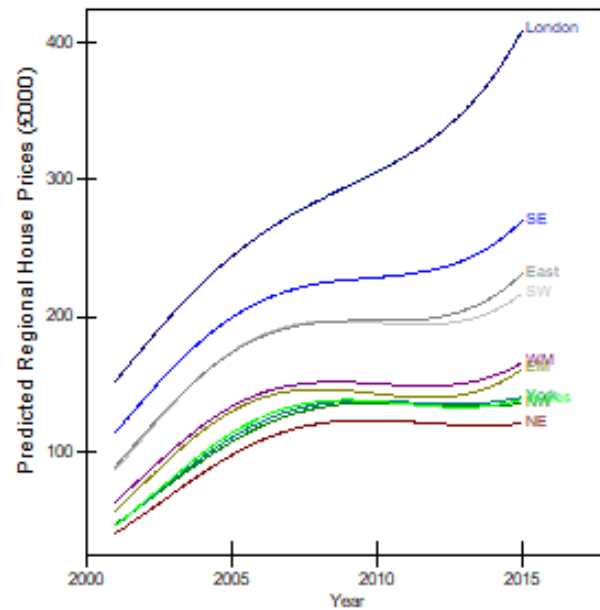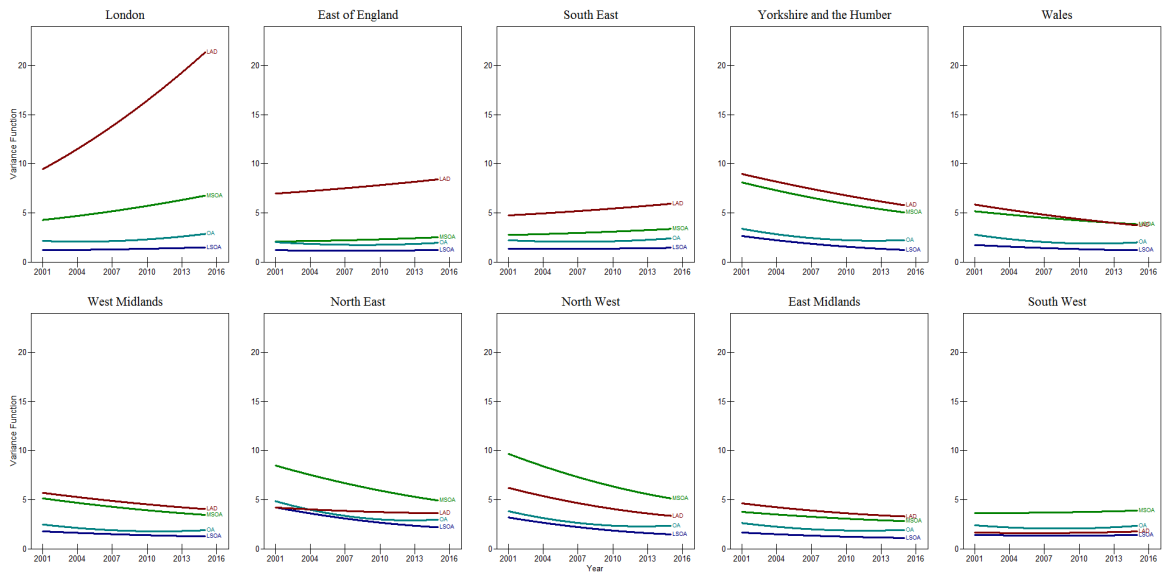
■ **Figure 1** Modelled mean house price for each English region.
Note: SE=South East, East=East of England, SW=South West, WM=West Midlands,
EM=East Midlands, York=Yorkshire and Humber, NW=North West, NE=North East

3.2 Chaning Inequality in House Prices within Regions

The changing inequality in house prices at a sub-regional level is explored between the
LADs within regions, between MSOAs within the LADs, between LSOAs within MSOAs
and between OAs within LSOAs. The estimated variations in house prices at these four
scales were presented in two steps: without and with adjusting for housing stock attributes,
presented in Figure 2 and 3, respectively.

The overall changing patterns between the two graphs are broadly similar; controlling
for the housing stock characteristics simply further brings out the importance of geography,
particularly at the broad district or borough level in London and the East of England. The
between-LAD variations in London the largest amongst in all English regions and they have
risen sharply during the overall period, while the between-LAD variations in all the other
regions are comparatively much smaller. Geographies in London, especially at the macro
level, are much more important in house price determination than in any other regions and
become more so over time.

Figure 2 Changing within-region price variations without adjusting for housing attributes.
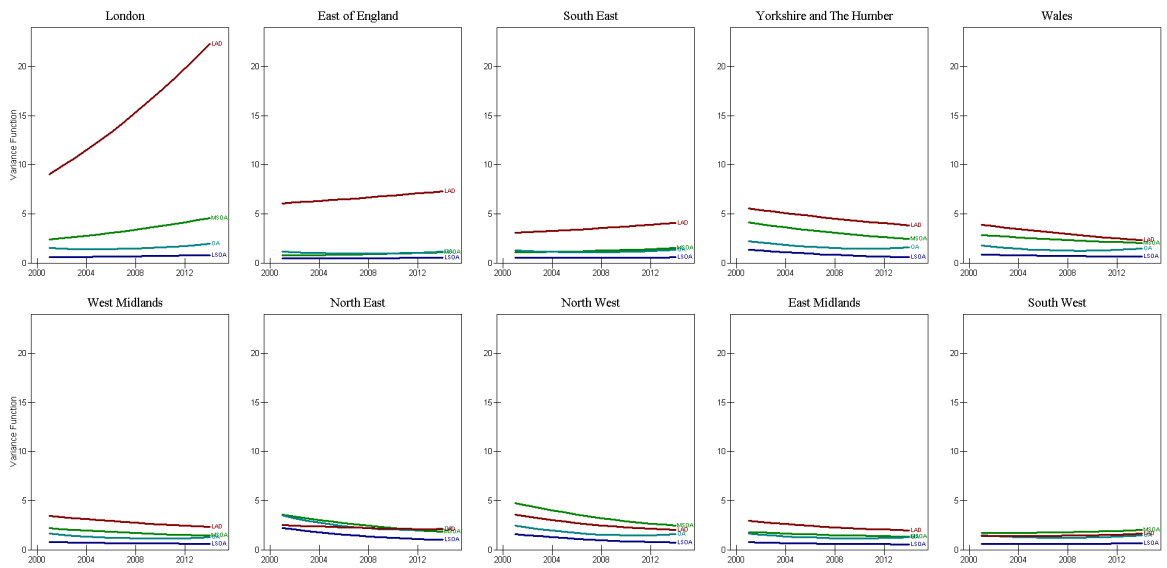
Figure 3 Modelled mean house price for each English region.

4 Discussion and Conclusion

Many previous studies found that substantial house price disparities exist between regions, and there is a clear North-South divide. The analyses at a sub-regional level, including the changing patterns in house price disparities, are however under-researched. This study presents a new spatio-temporal approach and applied it to historical individual house-level transactional data in England over a 14-year period and the results suggest that the geography of house prices is much more complex than a simple North-South divide.

We have three major findings. First, house price disparities exist at multiple spatial levels: at both regional and various sub-regional levels. Second, The regional price differences narrowed during the first half of the study period but widened after the global financial crisis in 2007/08. Third, the changing patterns of price variations within regions depend on the region and spatial level concerned. At the LAD scale, spatial disparities have mostly decreased. The magnitude of the disparities is substantial for some regions.

It was found that London is very different from the rest of English regions in many aspects. Its spatial inequality is the largest compared to the rest. This inequality has also increased substantially during the overall study period, irrespective of the level of the deprivation of the place. At any given time in London, greater price variations exist between affluent areas than deprived areas, while it is completely the opposite for other English regions. In addition, urban houses do not appear to be more expensive than the urban ones, after adjusting for the housing characteristics. This study also demonstrates the advantages of a random-effects approach to analysing the changing effects of the spatial units at multiple scales on house prices over time.

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