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The spatial economy can be visualised as a web of overlapping markets or functional areas linked to different activities but research and policy practicalities require linear boundaries to such areas. As a result the definition of functional economic areas (FEAs) has been a long term challenge of urban and regional analysis. Unfortunately very often administrative regions and local authority areas are used as proxies, but they have serious shortcomings for spatial economic analysis and the implementation of local policies, such as those focused on local labour or housing markets or retail systems. This problem is reinforced by the static nature of these boundaries in contrast with the substantial decentralisation within the spatial economy over the last forty years. These arguments have supported the rise of the city region (CR) concept over the last decade as a frequently stated preferred locus for urban governance, rather than the traditional focus on a core city. Indeed this use of CRs has become popular across the European Union (EU) (Healey, 2009).

In parallel the emergence of spatial planning in the UK has also supported a framework of functional areas, that in particular has reinforced the importance of CRs as local decision making structures. Yet despite the reams of policy documents and reports the clarion call for CRs as FEAs it has brought in practice a geo-political dimension to their definition, certainly in the UK (Coombes, 2014). This political focus has meant that CRs simply adopt arbitrary administrative boundaries, usually a combination of local authorities. This deficiency is compounded by a 'laissez faire' or do it yourself local bespoke approach to such functional geographies, that means not least that there is a lack of uniformity/ comparability between areas. More fundamentally it leaves questions about their usefulness. The EU too is promoting the use of CRs, in the same way, without a formal common definition even within countries.

This discussion about the theory and application of CRs is symptomatic of a wider issue about the lack of a suitable functional framework for the spatial economy. CRs are self-evidently just a partial element of a wider regional economy and one form of FEA (Parr, 2014). Some commentators for example have stressed the emergence of mega-CRs as FEAs, in terms of innovation within a context of increasing global information flows and international competitiveness based on the arguments of Scott (2001). Despite the long term academic concerns about the limitations of administrative boundaries and the growing public policy interest in FEAs there are no systematic national geographies that encompass the multi-functional nature of the spatial economy (Coombes, 2014).

In their absence labour market areas based on commuting patterns known as travel to work areas (TTWAs) in the UK have often been accepted as the basis for national studies since the 1980s (see later for USA). These areas by definition take no explicit account of other economic functions and flows, such as those linked to housing or services, or any notion of hierarchy. They are also too small to provide a framework to analyse large cities. A number of influential UK studies have therefore been content to use the built up area as a definition of a primary urban area (PUA) (eg Parkinson et al, 2006; Centre for Cities, 2015). These PUAs have a minimum size cut-off 125,000 in terms of their 2001 population. This definition produces a total of 56 PUAs in England containing 58% of the population and 63% of its employment in 2001 (Parkinson et al, 2006), but this geography has been recognised as not matching with many FEAs (Centre for Cities, 2015).

The aim of this paper is to address the vacuum in the application of metrics to the identification of FEAs, drawing on and informed by an overview of the spatial economy. It addresses both spatial boundaries and the classification of FEAs. In this paper a wide vision

of the spatial economy is taken that embraces the interaction of labour and housing markets together with a central place structure. It is recognised that spatial functional boundaries are inevitably fuzzy, potentially overlapping, and while a set of delineation decision rules need to be agreed there will be inevitably a degree of arbitrariness at the margins (Coombes, 2014).

The paper begins by an examination of the structure of the (changing) spatial economy. It then reviews recent definitions of urban forms, and by looking at their limitations draws out some principles to be applied in the construction of a comprehensive geography of FEAs. The paper then focuses on England as a case study. It reports on different geographies for England based on commuting and migration flows that extend the research of Jones et al (2012). The paper considers the implications for such geographies of varying definitions and draws out issues of spatial scale and the tiered nature of the spatial economy. The subsequent section looks to build a typology of these functional areas through the addition of central place criteria. Finally the paper draws some insights about the current functional economic geography.

The Structure of the Spatial Economy

The spatial economy can be seen as the interaction of inter-related labour and land use markets. The classic characterisation is of a uni-nodal city/town with the predominant journey to work from the residential suburbs to the inner ring of the urban area. The local labour market is defined by the suburban limits to commuting and this coincides with the urban built up area. Each city represents the peak of an urban hierarchy of central places and surrounding rural areas. This model no longer is closely related to reality as the spatial

economy has been transformed over time not only by increased urbanisation but also through decentralisation/ deconcentration. This has involved both the reconfiguring of the internal structure of cities and also the distribution of 'city' sizes within the urban system (Parr and Jones, 1983). Changing intra-urban land use patterns were initially driven by deindustrialisation in western economies and decentralisation/deconcentration of manufacturing industries (Ingram, 1998).

There was an expansion of core cities as services centres from the 1980s (except Liverpool) but even faster growth at 'decentralised' free standing or 'sub-dominant' centres (Jones and Orr, 1999).   Office requirements have also been rethought as a consequence of the ICT revolution, changing the nature of business demand for office space and the range of acceptable locations. The 1980s saw decentralised business space in the form of office parks begin to be built in the UK (Jones, 2013), and the emergence of what were coined edge cities in the USA (Garreau, 1991).

The trends in offices are paralleled by a similar rationalisation in the retail sector. The high/main street, the principal locus of shops from the nineteenth century, has been challenged by new retail forms. In the early 1970s in the UK the beginnings of fundamental change began to emerge as expanding car ownership underpinned a grocery-led exodus from town centres, which was quickly followed by the development of out of town regional centres as well as new innovations such as retail warehouses and retail parks (Schiller, 1986). In the US this process began much earlier: the first covered suburban covered shopping mall opened in 1956 (Eppli and Benjamin, 1994).

These trends are illustrated for England by Table 1 that lists eight out of town purpose built shopping malls that have been built since the 1980s in the top 45 retail localities.   To a degree

retail (and offices) decentralisation reflects the long term changing spatial distribution of the population. Suburbanisation in turn reflects growing household affluence, the rise of the car, and changed accessibility relationships linked to road improvements (Jones and Watkins, 2009). In the USA the suburbs are now the home for example for one in two of the population (Lang et al, 2005). But it is also clear that commuting patterns have evolved with these urban changes, and as people have been able and willing to travel longer distances to work so spatial labour markets have got larger. This new dispersed urban world is no longer defined by the physical built up areas.

Instead a polycentric urban form comprising a series of sub-centres with a range of functions can be visualised, and indeed was identified as far back as the 1970s in Los Angeles (Gordon et al, 1986). Lee et al (2006) find a decreasing share of commuting trips to the cores of American cities during the 1980s. Even by 1980 they report that suburb to suburb commuting was already predominant, and the trend continued into the 1990s. They also find a growth in core to suburbs commuting in the 1980s. Commuting is no longer simply from the suburbs to the city centre but is more often circumferential from suburb to sub-- centre.

As part of this process of dispersal the intra-regional system of urban areas has become more integrated, certainly in terms of commuting linkages. In Europe this phenomenon has been encapsulated in the introduction of the CR concept (Parr, 2005). In the United States authors have sought to dissect these new urban forms further. On the one hand Gottmann (1961) referred to 'megalopolis' to reflect a multi-nodal yet connected urban structure, while Vance (1977) identified 'urban realms' as semi-autonomous areas in the urban system (Lang and Knox, 2009).

More widely a new dispersed sub-regional urban system has emerged in which the key accessibility relationships have been transformed from those just focusing on one central urban core to regional centrality nodes (Dunse and Jones, 2005). Freestanding towns outside old urban cores can now exploit new locational advantages created by better transport networks (Parr and Jones, 1983). In contrast a 'rationalisation' of the retail hierarchy has also seen large centres grow at the expense of small town centres that have gone into decline. There is little hard evidence on this trend but it is illustrated by Genecon (2011) that finds a large increase in clothing and footwear stores in UK regional centres with a parallel decline in sub-regional and town centres over the period 1998-2010. These phenomena have given rise to the term polycentric urban region and urban networks with an implied shift away from a central places hierarchy.

There is a suggestion by many authors (eg Camagni and Capello, 2004) that these networks form an integrated regional economic entity in terms of cohesion in inter-firm relationships/interaction, while complementarity of functions exists between centres. However, this concept has been challenged by Oort et al (2010) based on research of inter-firm relations in the Randstad, seen by many as the archetypical polycentric urban region. On the one hand they find that that 50 per cent of the inter-firm relations are with (inter)national regions outside the Randstad. On the other there are still strong inter-firm and commuting relationships within the four individual cities that comprise the region.

Further evidence that cities are not developing as fully networked polycentric urban regions is provided by Goel et al (2010) from a study of commuting flows in the Greater South East of England. The study finds that this region is not (yet) a fully integrated urban network, and the results support a mono-centric view of the South East at the inter-urban scale. However, beneath this central pull the study does not find a hierarchy in the inter-urban

interdependencies. At the same time there are strong spatial interdependencies within suburban districts, suggesting that suburban nodes are increasingly operating in a manner independent of central London. Overall the region has both polycentric and hierarchical tendencies in terms of commuting flows.

Beyond the polycentric urban regions (as a simple description) there are rural and deep rural areas with limited links to them. The traditional idea of a market town is as a focal point of trade and services for a rural, primarily agricultural, hinterland (Powe and Shaw, 2004). The reality today is more complex for while market towns provide public services such as health and schools, leisure activities and food purchases, increasing car ownership has led to a restructuring of the inter-urban retail hierachy (as noted above) with comparison goods now predominantly purchased in core cities (Guy, 1990).

A continuing theme is the role of polycentric urban forms although definitions of polycentricity in the literature can be different when applied at different spatial scales and overlap with hierarchical patterns (Davoudi, 2003). At the intra-urban scale, a polycentric city often consists of a larger centre and a number of concentrated sub-centres with functional dependence on the larger centre in a continuous built-up area (Gordon et al, 1986; Chin, 2006). There are two types of these sub-centres: those developed based on old towns that incorporated into an expanded but coherent urban area; and those newly developed at nodes of the transportation network (Anas et al, 1998). The definition of polycentricity at the inter-urban scale refers to an urban region characterised by separate and distinct cities or smaller settlements with significant interactions to each other (Dieleman & Faludi, 1998). The rise of the polycentricity concept to explain urban systems has been paralleled by the lack of an accepted definition and its application both to the spatial structure of intra-urban areas, as well as inter-urban (and more 'mega') levels.

To conclude the analysis above argues that urban/rural forms have evolved over the last half century, and in the process spatial land use patterns and structures no longer conform to either the fundamental assumptions or outcomes of longstanding theories. The overall 'new' geography appears as partly polycentric, not just at the inter-urban level but also at the intra-urban level, and linkages such as commuting flows have become more diffuse. As a result spatial housing and labour markets have become more dispersed. Nevertheless the vestiges of a pared down central place hierarchy appear to remain, although its structure is blurred. The analysis is incomplete and to a degree speculative because of gaps in empirical studies but it offers a context to the analysis below. In the next section the attention turns to attempts at formal and practical definitions of functional concepts that address this new world as a step toward a more general geography of FEAs.

Defining Functional Areas

Reflecting today's dispersed spatial economy recent academic research has focused on the nature of new urban forms in a regional context. A useful starting point to a review is the concept of the CR as they can be seen as the pinnacle of many sub-regional urban systems. Marvin et al (2006) initially define CRs as,

"enlarged territories from which core urban areas draw people for work and services such as shopping, education, health, leisure and entertainment." (Summary, para 1, p5)

Hall (2009) following Castells (1989) has defined a CR more abstractly by reference to the 'space of flows', namely regular flows of people, information or goods including commuting and shopping.

In an alternative theoretical perspective Parr (2005) distinguishes between the C and S zones of a CR, with C representing a centre of service provision as well as an important transport and communications node. Urban centres in the surrounding S zone are linked economically to the C zone of the CR (rather than another C), so that the economies of the two zones are linked together and the performance of one impinges on the other; and there is a high level of 'self containment' within a CR. Parr's model is abstract but C zones would be identified by a set of criteria by reference to either function or minimum thresholds. These could potentially encompass population, employment, gross domestic product, international airline connections, other major transport links, telecommunications traffic, bank turnover, etc. The boundaries of a CR are then to be determined by the degree of trade interaction with C (he does not distinguish criteria for C and S). While he acknowledges the potential for migration and travel to work patterns in this regard he sees sole reliance on either of these as 'restrictive'.

Parr's CR can be seen as a form of 'functional urban region' (FUR) first developed by Berry et al (1968) as both are based on a core/surrounding zone(s) model. The concept of a FUR has provided the basis of the classification of metropolitan statistical areas for over 50 years in the USA. The latest manifestation of definitions (that have been refined every ten years or so) to address increasing dispersal are in three tiers – 'metropolitan statistical areas', 'core based metropolitan statistical areas' and 'micropolitan areas'. These are defined by a combination of a core population size and surrounding areas with prescribed commuting

links. Many districts of the country remain outside this classification and by default are 'non-metropolitan' (Hall, 2009).

Hall and Hay (1980) applied the essential FUR idea to 539 selected areas across western Europe. The FURs in this study were defined as urban cores, comprising cities of 50,000 inhabitants or more together with their spatially contiguous hinterlands, delineated so as to ensure a high degree of closure of commuting within the regions. The actual criteria applied allowed for missing commuting data in some countries. There have been a number of subsequent cross-border studies of urban functional geographies, spawned first by the European Spatial Development Perspective (ESDP) and then the European Spatial Planning Observation Network (ESPON), but like their earlier counterparts they suffer from pragmatic approaches to inconsistent data and arbitrary criteria (Korcelli, 2008). The focus of these studies was also more on typology than boundaries.

A polycentric urban region (PUR) is a further potential form of a functional system of areas. Unlike the FUR, the PUR does not contain a dominant node but despite it receiving an enormous policy commitment from the EU the precise underlying definition has not been fully developed. One simple 'physical' definition is,

"...a region having two or more separate cities, with no one centre dominant, in reasonable proximity and well-connected.". (Bailey and Turok, 2001, p 698).

Parr (2004) sets out seven general conditions for a PUR that also extend to high levels of interaction between localities, while suggesting specialisation between centres (as discussed and disputed in the previous section). His analysis emphasises the difficulty of measuring the polycentricity of an urban system a whole.

More recently studies have identified mega-CRs seen by Hall (2009) as between twenty to fifty urban areas, forming a functional network or cluster around one or more cities and representing contiguous aggregations of FURs. As conceptualised by Hall they are similar to 'consolidated metropolitan statistical areas' in the USA. He envisages such entities as including London and the South East of England, the Randstad in the Netherlands and Rhine-Ruhr and Rhine-Main in Germany. These mega-CRs are formally defined as in the Parr (2005) framework by a core and surrounding ring. A qualifying core is defined in terms of employment size (20,000 workers) and density, and the ring by 10% or more of resident workforce commuting to the core (Hall, 2009).

Overall these 'definitions' of (systems of) urban forms noted above are described in terms of both settlement size characteristics and interdependencies. Studies presume a degree of centrality in the form of periphery-core relations, and while polycentricity has a wide intuitive appeal there is a lack of a practical operational model that encompasses a hierarchical structure. In the main administrative boundaries are used and there is virtually none or almost no reference to the areas beyond the boundaries, which are seen as 'islands'. Juxtaposing these definitions and conclusions with the discussion from the section on the spatial economy identifies key absences to the criteria, and raises a number of challenges to constructing functional geographies. There is no linkage to urban services functions or retailing hierarchy. Instead the definitions above are 'one dimensional' in the sense that flows are concerned with only commuting/urban labour markets. The role of local housing markets and migration flows are largely ignored, as are shopping and trade flows.

Further while these studies in the main incorporate a core/ periphery framework reflecting the continuing role of central place(s) in the national urban system the practical core and

periphery distinctions suffer from an arbitrary areal definitional problem (Coombes, 2014). In addition the review of the spatial economy demonstrates accessibility relationships across a whole sub-region (not just with one central place) are now critical to the location of land uses. It is therefore more appropriate to take an agnostic view to the defining of the spatial geography through the prism of economic flows (framed by transport infrastructure/accessibility relationships) without any a priori framework. Such flows represent the key to measuring the structure of the spatial economy and FEAs.

Where does this leave the identification of FEAs? There is a need for a more flexible model of FEAs that can incorporate:

- Areas with no clear central node necessarily within them

- A comprehensive geography that embraces peripheral areas

- Areas identified from economic flows

- A central place element

The current UK TTWA geography partly meets these criteria designed to define local labour market areas (LLMAs). Based on theory set out by Goodman (1970) spatial labour market areas are defined by analysing relatively self-contained commuting patterns to identify localised clusters of journeys to work. The boundaries of the labour market area are such that most buyers and sellers of labour are interacting within it to establish wage rates (prices). The 'official' TTWAs are constructed in this way although it is necessary to select a

level of commuting closure (Coombes, 2010). The minimum level applied has been lowered over the years and is currently (2001 based) 66.7% which produces 140 TTWAs in England but at this level of closure the urban areas derived are relatively small, and certainly smaller than the built up areas of major urban areas (see further discussion below). For our task this geography suffers from producing areas that are too narrowly defined in spatial terms and economic flows, and lacking central place criteria. It offers very little insight into the functional dimensions of the spatial economy.

A Geography of FEAs

We now develop a functional geography for England that seeks to meet the criteria for FEAs set out above, and is of general application to other parts of the world and pan-European planning policies. The first step is to combine spatial labour markets and the role of the local housing markets in a **tiered** view of the spatial economy (Jones et al, 2012). The analysis centres on (wide) LLMAs bounded by the distances travelled by the furthest commuters in different directions from a dominant accessibility node. This geography is then extended by incorporating a superstructure of central places on the upper tier to produce a hierarchical classification of functional economic areas.

The geography is generated by applying a grouping algorithm to sets of commuting and migration flows. The tiered geography is derived by constraining or embedding the boundaries of local HMAs, derived from migration patterns, within those of a local labour market identified by commuting flows. It clusters commuting and migration flows between wards (the lowest areal unit available) identified from the 2001 Census, without any presumption of any core-periphery structure. The algorithm seeks to identify as many as

possible separate areas which meet the key criterion of a set level of 'closure' (ie. the proportion of the flows analysed which both start and end within the same area). It does this by grouping areas in whatever way minimises the number of flows that cross their boundaries. The algorithm is that applied to identify official TTWAs in the UK (Coombes, 2010).

There are no precise levels of migration or commuting closure guided by theory to construct this geography. However, an important theoretical criteria applied is that HMAs should be embedded in labour market areas. This follows from access-space models of urban housing markets in which the journey to work is the key force in shaping spatial house price gradients (eg Muth, 1969, Evans, 1973). While these models are simplifications of the real world empirical price studies consistently find a significant distance decay function from central urban locations (see Jones et al 2009, for example). The implication is that the limits to local HMAs are determined by travel to work patterns, and their outer boundaries are determined by the distances travelled by the longest commuters in different directions from a dominant accessibility point. Based on this principle the analysis therefore applies higher levels of commuting closure than that used for UK TTWAs (which produce areas that are too small) so including long distance commuters. From this starting point a series of tests generates the preferred geography of Jones et al (2012) given by closure rates of 77.5% for commuting (daily flow) and 50% for migration (periodic flow).

Map 1 presents this geography, and the labour market areas defined in this way generate 13 areas with populations of more than 750,000. These include the nine largest urban areas identified by Parkinson et al (2006) based on built up areas but also encompass areas centring on Brighton and Reading (both with larger 2001 populations than the Bristol area),

Milton Keynes and Stoke on Trent. These areas are identified spatially on a common basis but there are clear differences between them in terms of their roles as central places (see later).

Based on the given commuting closure criterion there is a very large Greater London urban area, having a population of over 11 million, but it does not encompass the whole of the South East. Nevertheless it gives credence to the concept of the London mega-CR as promulgated by Hall (2009), with Birmingham and Manchester both the order of a quarter its size in population terms. These differences infer that the concept of the CR is primarily confined to the north. The analysis suggests that there is no UK 'region' that on the basis of commuting flows can be identified as one functional PUR (using Bailey and Turok's (2001) simple definition): Greater Manchester and Merseyside are separate labour market areas within the North West administrative region and similarly Leeds and Sheffield are distinct within Yorkshire and the Humber region. The other large labour market areas are substantially smaller than what is generally perceived of as a region.

This broad geography and conclusions hold if the criteria are varied upward (downward and we are close to TTWAs with their limitations). Raising the commuting closure rate to 80% and leaving the migration closure as 50% is shown in Map 2. The striking difference is the extension of the Greater London functional area to encompass Hastings on the south coast, parts of East Anglia such as Colchester, Reading to the west, and Oxford and Cambridge to the north – ie many satellites, but not the whole of the South East administrative region. Reading and Milton Keynes labour market areas based on 77.5% closure then disappear into Greater London. In comparison there are only marginal extensions to the other 'CRs', often to embrace rural areas and market/small towns: Newcastle extends into northern rural Yorkshire to embrace Thirsk and Bristol expands to

include surrounding towns, such as Bath. Leeds encompasses the neighbouring town of Bradford and rural areas to the north-west. Birmingham has reached west to draw in the large urban areas of Wolverhampton and Worcester. Overall the outcomes from both geographies do not support the prevalence of provincial PURs containing two or more large cities, despite their policy prominence in Europe.

HMAs embedded within these LLMAs show a marked distinction in spatial scale between the southern and northern urban areas. The HMAs in the North East have particularly tightly defined small areas. Given that all HMAs are defined by the same criterion it appears that there are substantial differences in migration patterns not just between rural and urban areas, but that there is also a north-south divide.

Classification of Functional Areas

A typology of areas is now developed by classifying the (77.5%) labour market areas/FEAs above by a combination of functional criteria - number of HMAs embedded and the highest central place function within each area's boundaries, together with density/population. Density is included as a measure of the scale and nature of economic activity. It is at its highest in the Greater London FEA at 13.8 persons per hectare just ahead of Liverpool and Birmingham and Manchester. But density on its own cannot differentiate or classify functional areas as the high density for the Liverpool FEA demonstrates. Broadly the following groupings based on density can be identified – urban (4.5-6.5), predominantly urban (3-4.5), predominantly rural (2-3), and rural (<2), although our final classification is more pragmatic. The number of HMAs in a FEA tends to increase with density and is of limited relevance on its own to any typology. Its classification role is in conjunction with a

level of central place (defined by reference to retail or intermediate (non-household) services) in a FEA, and as an indicator of spatial structure.

The review of the spatial economy suggests that there is now only a limited central place inter-urban hierarchy relating to retail services, dominated by large centres but complicated by out of town malls. There is also a parallel if less visible consumer/business services hierarchy located in offices (Jones, 2013), which has been under-researched. The research question is to identify a hierarchy. Looking first at shopping, Reynolds and Schiller (1992) identified an inter-urban hierarchy of 826 UK centres in 1989 based on the number of multiple (chain) retailers in each centre. This comprehensive study has not been updated but points to the use of retailer types for our task. Unfortunately there is only incomplete data available today from commercial sources and the Valuation Office Agency, as summarised by Table 1 on types of shops in shopping centres. Nevertheless there is complete information on (estimated) sales in retail centres at the top end of the national hierarchy. Although there are gaps in the evidence on shops and rents there are reasonable correlations between the incidence of 'primary shops' (0.76), rent levels (0.58) and retail sales in centres. A similar conclusion can be drawn from comparison of the distribution of head-line office rents, derived again from incomplete evidence from the Valuation Office Agency, and floorspace in each centre from CoStar (correlation = 0.98). These correlations suggest that the choice of classification variables is not crucial, and so the study here is based on the variables for which there is the most complete data. The correlations also indicate that despite the data gaps the table provides a reasonable representation of the spatial economy of offices and shops in major centres.

The approach here is to base the retail hierarchy on retail sales and an office hierarchy on rent levels of city/town centres. This data is drawn from secondary sources and beneath the

surface there are a range of concerns about collection and spatial definition that may cause inaccuracy. The use of retail sales (excluding food) to measure the role of a centre in a hierarchy is also potentially biased by differences in regional incomes. These problems are to an extent diffused by using the data simply to group centres, and there is a degree of arbitrariness to the identification of tiers in an urban hierarchy. The rental data is only available for what the VOA (2011) regard as the most important centres.

The centres in Table 1 are ordered in terms of the magnitude of shopping sales (the top 50 centres in the UK less 5 in Northern Ireland, Scotland and Wales). Five of these shopping centres are in central London, and together with six satellite centres and four purpose built centres there is an internal retail hierarchy within the London LLMA/FEA. This is not surprising with a population of over 11m. With 230 million square feet of space the central London office market also dwarfs the rest of the major cities combined. Office space is more spatially concentrated in centres across England compared to retail sales. Nevertheless the 45 top retail centres are located in only 23 of the 56 PUAs, noted earlier, demonstrating a deviation between major retail and population centres (reinforcing the argument about a collapsed retail hierarchy).

Judged on the data there are also differences between individual city/town centres in their relative roles as shopping and office localities. Notably Nottingham, Leicester and Norwich are more significant as retail than as office centres. This complicates classification of centre functions, a task which is further obscured by the decentralisation trends discussed above. It is exemplified by the significance of purpose built out of town shopping centres in Table 1. Rents in these centres are higher than their neighbouring city/town centre. These challenges are addressed in a classification by combining the retail sales of out of town and

city/town centres within a given FEA, and defining a particular centre by its highest central place function (offices or shops).

Using these criteria three tiers of a central place hierarchy (embedded in FEAs) can be discerned below the mega CR of Greater London, that take into account significant breaks in the spectrum of retail sales:

- A top tier of provincial centres having the highest ranking of retail sales (>£800m) or office rents (>£225/sq m). Centres that qualify on these criteria are Manchester, Birmingham (with Solihull), Sheffield, Newcastle upon Tyne, Leeds and Bristol.
- Tier 3 centres with retail sales of £450-800m. This tier consists of the eight centres of Nottingham, Liverpool, Leicester, Reading, Southampton, Norwich, Cambridge and Brighton (with tier 3 Crawley).
- Tier 4 centres with retail sales £260-450m. There are nine centres in this tier - Oxford, Hull, Plymouth, Milton Keynes, Derby, Bath, Exeter, York and Northampton.

This geography differs from what might be described as a traditional perspective on the urban system as exemplified by placing Liverpool in tier 3. There is also the absence of many of the PUAs identified by Parkinson et al (2006), such as Stoke, in these three tiers. Incorporating office floorspace as a criterion rather than rents would place Liverpool in the top provincial tier but make no other difference. Office rents are used rather than space because it is a more current measure of the local economy.

These tiers of the urban hierarchy are now combined with population densities and HMAs to construct an indicative but more detailed typology of functional areas that is presented in

Table 2. This nine fold classification aims to highlight the nature of functional areas rather than be definitive given the data limitations. At the pinnacle is Greater London as a mega-CR that stands out above the other areas in terms of the scale of retail sales/office space. Six CRs are defined by reference to their place (tier 2) in the central place hierarchy. This chimes with Parr's (2005) notion of a required functional threshold for (a core of) a CR and also extends his analysis by placing a CR within an urban hierarchy. FEAs with a tier 3 shopping centre in the hierarchy are split by the degree of density. Functional areas with tier 4 centres also have lower density. Beneath these five urban tiers FEAs are classified as rural or predominantly urban on the basis of density. These FEAs have no recognised shopping centres of tier 4 or above, except for a group of centres with major shopping centres set within rural regions.

The groupings are broadly internally coherent with a few exceptions. Liverpool and Nottingham perhaps do not sit easily together. The most diverse group is the predominantly urban areas with no major shopping centre as it includes traditional manufacturing areas and holiday resorts. Outside the major cities the number of HMAs broadly equates to the number of urban centres in a FEA.

An abridged central place hierarchy is central to this classification and ignored by previous geographies. The typology draws out some key aspects of the current spatial economy. Many former large manufacturing centres are significant loci of population, and identified as PUAs by Parkinson et al (2006) but are no longer functional central places. The role of retail centres in these traditional industrial areas has been diminished. However, these PUAs still retain a focus as local HMAs.

Conclusions

The spatial economy has become more dispersed over the last half century through a combination of deindustrialisation, deconcentration, decentralisation and suburbanisation. In the process the typical uni-nodal urban form based on travel to work within a clear central place system of settlements has arguably been fractured. Both intra-urban and inter-urban land use patterns have been transformed. A sub-regional urban system now operates as a complex web or network, reflected particularly in commuting and shopping flows, but also by local migration patterns. While the traditional urban hierarchy has broken down regional centrality appears still a clear remnant of the bygone system.

Existing 'functional' geographies based simply on standard TTWAs and/or population do not capture this complexity. There have also been attempts to partially consider the nature of urban functional forms at the top end of hierarchy – CRs, mega CRs as 'islands'- or at a macro-regional level. While these studies and concepts have explored many of the underlying spatial economics they have similarly tended to take a partial view of economic flows. The aim of this paper has been to address this void by producing a comprehensive geography of FEAs, combining commuting and migration flows and central place characteristics. This approach is a major innovation and enables not only the identification of the mega CR of the South East and CRs located primarily in the north of England, but also other types of functional areas using consistent criteria.

This geography is sufficiently robust to make some conclusions about the English spatial economy. The urban typology derived based on functions (rather than populations) that emerges highlights core cities and medium sized cities now represent the primary retailing

and office centres. Many traditional population centres have had their retailing roles diminished but they continue to act as communities and local HMAs, despite the increase in commuting distances and the size of LLMAs. In the south HMAs tend to be larger suggesting the absence of these community pulls and there is a clear north-south divide in the character of the urban system.

Varying the criteria makes limited differences to the conclusions, although increasing the commuting closure level substantially extends the scale of the London LLMA. There are inevitable limitations as the geography has taken a pragmatic approach given the data available. In particular there are no shopping travel flows available and these would have enhanced our understanding of FEAs. The data on retail sales and office centre rents focus only on the higher tiers of the national hierarchy and so to a degree is also incomplete, and subject to potential queries about reliability. With all the methodological and data caveats the research findings still offer insights into various theoretical perspectives on sub-regional urban structures. The geography queries the relevance of core/surrounding models of urban form as large LLMAs comprise in some cases more than twenty HMAs. While the research uses England as a case study the analysis is of generic significance to understanding the spatial economies of developed countries.

The paper also offers a contribution to planning. There is a growing belief in the use of FEAs for making planning decisions. In the EU the last decade or so has in particular seen an expanding interest in the role of cities and CRs to regional and national growth. While there is a consensus that cities matter planning/local economic development policies need a clear and consistent approach to where do they start and end (Parkinson et al, 2006). There needs to be a holistic approach to FEAs that goes beyond the use of administrative boundaries. Current approaches to defining FEAs and CRs lack credibility and consistency

and make comparisons across countries, and even within countries, difficult. This paper offers a methodological way forward for establishing a framework for planning within national urban systems.

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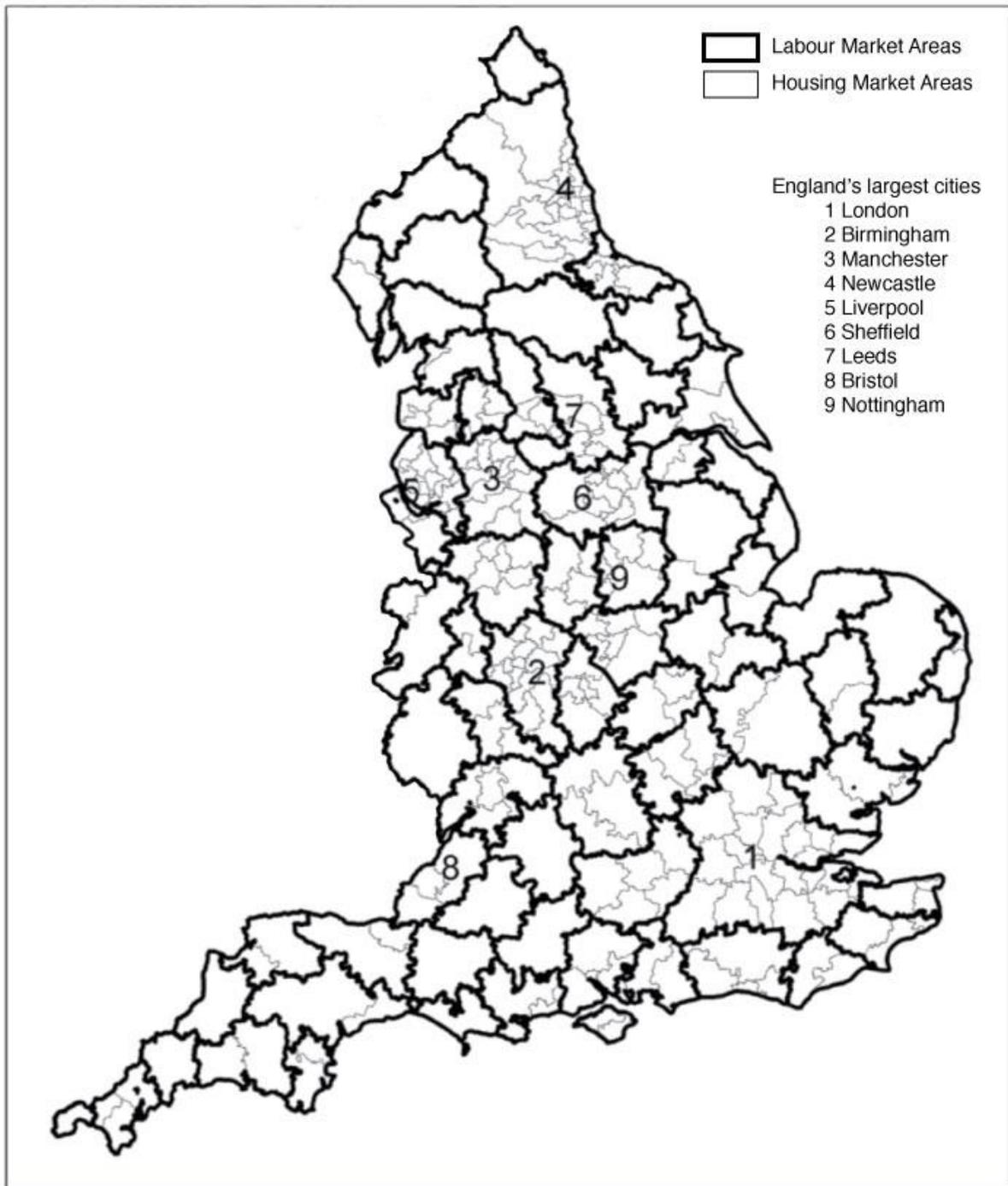
Map 1 Migration-based local housing market areas (50%) *within* commuting-based labour
market areas (77.5%)

Greater London	*11,263,679*	*Sheffield*	*1,429,814*
Birmingham	*2,881,860*	*Reading*	*1,364,540*
Manchester	*2,603,338*	*Nottingham*	*1,049,805*
Newcastle	*1,928,825*	*Brighton*	*991,310*
Liverpool	*1,804,903*	*Bristol*	*910,366*
Leeds	*1,593,775*	*Milton Keynes*	*872,077*
		Stoke on Trent	*786,312*

Map includes parts of Wales and Scotland because labour market areas overlap political boundaries.
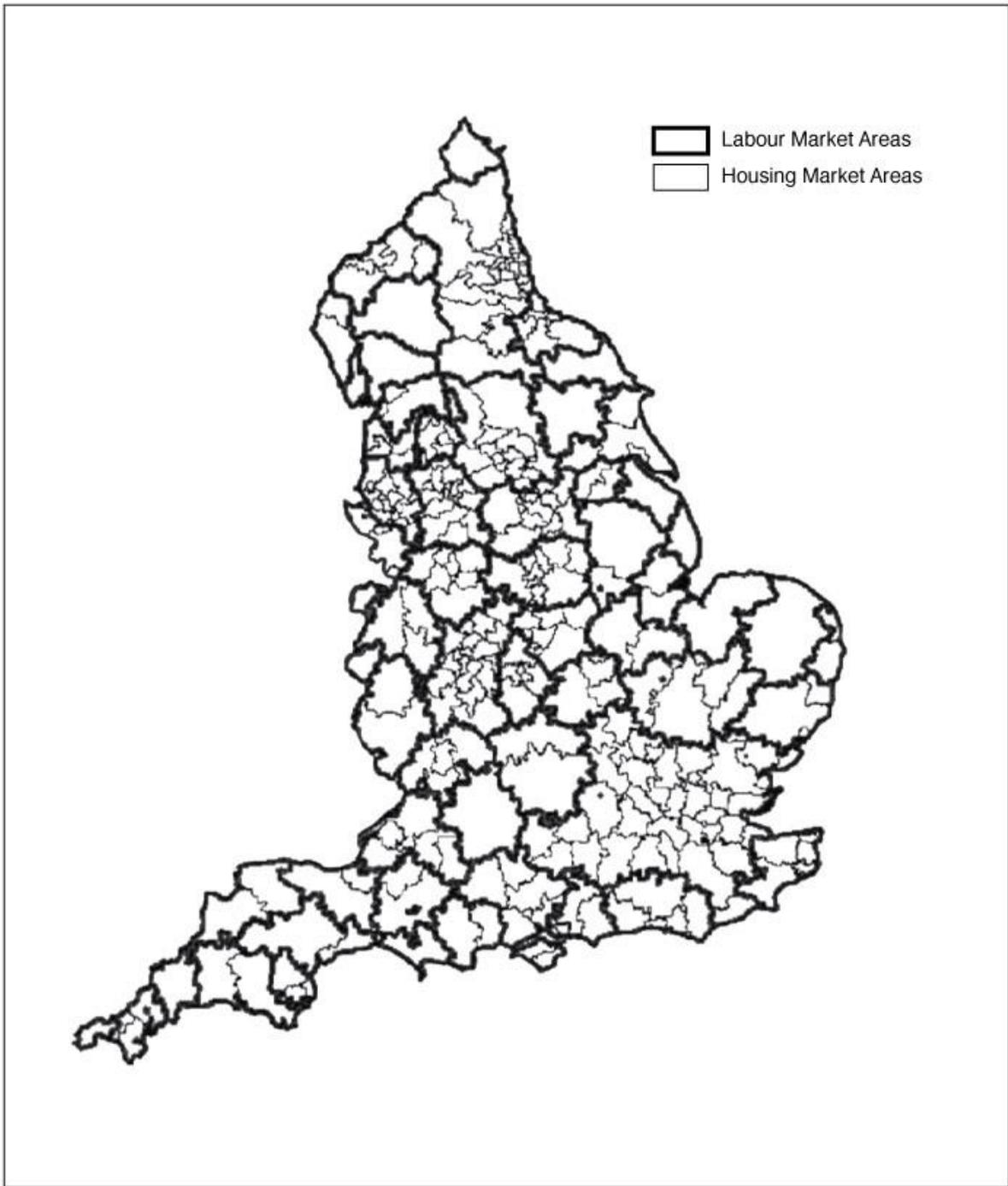
Map 2 Migration-based local housing market areas (50%) *within* commuting-based labour
      market areas (80%) in England

Map includes parts of Wales and Scotland because labour market areas overlap political boundaries.

Table 1 Retail and Office Market Characteristics of Major Centres

Shopping Centre Rank/ PUA	Centre	Retail Sales 2011 £m	No of Premium stores	Premium stores as % total	Head-line Retail Rents	Head-line Office Rents	Office Space million square feet
1 C London	Oxford Street/West End	1,624	90	21.8	6500	860	230.0
2 PUA	Manchester	921.1	96	12.4	2400	250	27.37
3 PUA	Birmingham	861.3	83	12.7	3300	260	23.62
4 PUA	Nottingham	734.7	53	10.1	2150	140	11.63*
5 C London	Knightsbridge	695.6	82	42.1			
6 PUA	Liverpool	693.6	53	8.8	1700	175	14.01
7 PUA	Leeds	652.2	56	9.3	2750	240	13.50
8 PUA	Leicester	641.8			1800	150	8.60*
9 PUA	Bristol	630.1	44	8.4	2300	230	12.14
10 PUA	Reading	628.7	39	8.7	1925	215	8.13*
11 PUA	Southampton	622.3			2800	185	4.18*
12 PUA	Norwich	559.0	42	8.4	1950	140	3.47*
13 PUA	Newcastle-upon-Tyne	526.8	45	8.9	3350	215	8.61*
14 London	Westfield Shopping Centre - White City	513.9	54	23.4	2750		
15 PUA	Cambridge	505.9	44	10.2	2900	245	3.93*
16 London	Kingston upon Thames	490.3	48	13.0			
17 PUA	Brighton	483.8	33	8.8			
18 Sheffield	Meadowhall Shopping Centre	474.3	33	12.5			
19 PUA	Sheffield	470.6			2400	165	13.78*
20 London	Bluewater Shopping Centre	467.4	61	21.3	4250		
21 London	Croydon	452.5			2100		
22 Manchester	Trafford Centre Shopping Centre	448.9	37	15.5	3875		
23 London	Brent Cross Shopping Centre	420.5	36	25.4			
24 C London	Covent Garden	398.0					
25 PUA	Oxford	363.4			2500	230	4.84*
26 PUA	Hull	363.1					
27 London	Guildford	356.3	49	13.2			
28 C London	Chelsea	352.8	50	21.6			
29 PUA	Plymouth	346.3			800	130	
30 Newcastle	Metro Shopping Centre	343.1			3500		
31 PUA	Milton Keynes	338.8	38	11.4			
32 Birmingham	Merry Hill Shopping Centre	336.5					
33 C London	Regent Street South	332.2	33	26.8			
34 London	Maidstone	315.7					
35 London	Bond Street	312.7					
36 PUA	Derby	296.0					
37	Bath	295.1	41	12.0			
38	Exeter	289.7					
39 PUA	Crawley	287.4					
40 London	Watford	282.5					
41	Solihull	273.1					
42 London	Lakeside Shopping Centre	269.9					
43 PUA	York	268.3					

44 London	Sutton	263.1					
45 PUA	Northampton	262.4					
PUA	Stoke				1500	95	

Sources and Notes:

Sales volumes are taken from Call Credit Information Group (2011) and are estimated from the summing the revenues of each store based on its size, location and revenue/floorspace ratios of the brand (from company/market reports).

Office floorspace data is for 2013 provided by CoStar for the largest city centres, and for local authority areas for smaller office centres (indicated by *).

Headline rents per sq metre represents indicative opinions of gathered by valuers for the VOA (2011). For shops these figures relate to a standard shop unit in a prime position in a principal shopping centre. Values for offices relate to a self-contained suite over 1000m² in an office block erected in the last 10 years, air conditioned with a lift, a good standard of finish to all parts but limited parking available with a town/city centre location.

PUAs are identified by Parkinson et al (2006).

Table 2 Indicative Classification of Functional Areas

Functional Type of LLMA/FEA	Characteristics	No	Centres
Mega City-Region	**Sales>£1bn and central office rents over £400sq/m**	1	London (including satellites)
City-Region – Tier 2 shopping centres or major office centres	**Either sales>£800m or office rents above £225sq/m**	6	Manchester, Birmingham (with tier 2 Solihull), Sheffield, Newcastle upon Tyne, Leeds, Bristol
Core cities with Tier 3 Shopping Centres	*** Sales £460-800m** *** Density over 6 persons/ha** *** Comprising 7+HMAs**	2	Liverpool, Nottingham
Cities with Tier 3 Shopping Centres	*** Sales £460-800m** *** Density over 4-5 persons/ha** *** Comprising 3-7 HMAs**	4	Leicester, Reading, Southampton, Brighton (with tier 3 Crawley)
Cities with Tier 4 shopping centres	***Sales £225-450m** ***Density between 2.5 and 4 persons/ha** ***Comprising up to 4 HMAs**	7	Oxford, Hull, Plymouth, Milton Keynes, Derby, Bath, Northampton
Rural 'Region' with major shopping centre	***Sales >£225m** ***Density less than 2 persons/ha** ***Comprising 1 or 2 HMAs**	4	Cambridge, Exeter, Norwich, York
Predominantly urban areas with no shopping centres in top tiers	***Density over 3 persons/ha** *** Normally 3 or more HMAs**	12	Preston, Bradford, Burnley, Portsmouth, Middlesbrough, Coventry, Ramsgate/Canterbury, Bournemouth, Birkenhead, Stoke on Trent, Isle of Wight, Eastbourne/Hastings
Predominantly rural areas with no shopping centres in top tiers	***Density between 2 and 3 persons/ha** ***Comprising up to 3 HMAs**	11	Colchester, Great Yarmouth, Torquay, Worcester, Gloucester, Telford, Barrow, Scarborough, Folkstone/Dover, Cleethorpes, Falmouth/Truro
Rural Areas with no shopping centres in top tiers	***Density less than 2 persons/ha** ***Comprising 1 or 2 HMAs**	25	Ipswich, Scunthorpe, Swindon, Weymouth, Peterborough, Penzance, Lancaster, Salisbury, Bodmin, Yeovil, Taunton, Lincoln, Workington/Whitehaven, Bury St Edmunds, Boston/Spalding, Kings Lynn, Skegness, Barnstaple,

			Hereford, Kendal, Carlisle, Thirsk, Bude, Whitby, Penrith