VISUALISING COMMUTING PATTERNS: EXPLORING CHANGING DYNAMICS OF COMMUTING DISTANCE IN ENGLAND AND WALES 1981-2001

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ABSTRACT

The visualisation proposed in this presentation provides a means for evaluating the whole set of commutes to work for England and Wales by clearly summarising the average commuting distances to and from each of the 8800 wards. By plotting these distances for 1981 and 2001 using UK Census information it is possible to see how the changing commuting preferences of workers have affected the functional areas of settlements. The dynamics that have led to this change can be explored through the separation of commutes by various subgroups, exemplified in this presentation through gender differences.

Categories and Subject Descriptors

J4 [**Social and Behavioral Sciences**];

Keywords

Commuting, visualisation, gender, labour shed, employment field.

1. INTRODUCTION: AIMS AND BACKGROUND

Functional urban representations are an essential part of spatial analysis as they bring to light labour dynamics that are not easily discernible. They are composed of 'labour sheds' or 'labour catchments' on the demand side, areas where workers are recruited from [1] and 'employment fields' or job search areas for workers on the supply side [2]. As labour sheds and employment fields concur they become more 'self-contained'. Identifying these areas has not been straightforward since labour markets have been prone to overlap and are very difficult to separate from each other especially when gender and occupational differences are taken into account [3]. The method I propose to use, multivariate functional representation is a step in solving these issues.

The aim of this visualisation is to represent the whole extent of commutes within England and Wales at local level within a single graphical representation and provide information on change in both labour demand and supply side dynamics.

Functional representations have a long history that dates back to 1885 and have continued to maintain the attention of researchers [4]. The most commonly used representation of functional regions in the UK are the Travel To Work Areas (TTWA) that are published by the Department of Employment [5]. For TTWA's, the researchers use an algorithm that has also been adopted by the EU called the European Regionalisation Algorithm (ERA) [6]. In contrast to analytical regionalisation methods where regions are created based on certain statistical values [7] [8] or clustering methods ERA's starting point for the creation of the regions are administrative authorities. The functional area is delineated by determining a threshold for self-containment such as percentage of commuting in versus commuting out. This method requires the selection of separate identifiable regions with a defined centre where all flow terminates and the origins have to be in a distinct region that surrounds it so self-containment thresholds have been increased for each census year. Overlapping conditions such as adjacent centres, clusters or polycentric structures are difficult to identify and distinguish. Representing the region within this formulation misses a lot of the complex dynamics underlying this structure and is insufficient in evaluating and understanding functional boundaries and the changes that occur over time.

2. DESCRIPTION

The discussion on functional change will revolve around commuting between home and work. Each labour shed has its counterpart employment field which is comprised of the set of destinations that are connected to a ward of origin by commuting ties. Although there are a total of 8800 wards they have dual identities, bringing the total to 17,600 in a fully functional settlement representation. I will incorporate employment fields and destination wards by considering the average commuting distance by ward of origin to be the equilibrium distance for commuters living within that ward and plot this along with the average distance by destination ward. The simultaneous plotting of average distance by ward of origin and destination will determine the relationship amongst these two values.

Conducting an analysis based on the Census Interaction Datasets of the UK Census requires a well-thought out methodology because of the size and complexity of the data. For 2001 each matrix contains 8800 rows and 8800 columns creating a table that contains 77,440,000 records. Incorporating analysis that takes into account only origin, only destination and both origin-destination datasets requires a geographic dataset that could be accessed readily and that would yield reliable results within a reasonable time frame. This can be achieved in the most efficient manner by keeping the dataset within origin-destination matrices tied to particular geographic locations so that the queries can refer to rows, columns or if necessary particular cells in the matrix. The way that most of the geographic processing software is constructed, there is no straightforward way of storing this type of information [9]. The second critical element of the analysis would be running statistical analysis on the matrices multiple times so that combined results can be achieved. This functionality is within the scope of statistical software packages. However running large number of iterations can become problematic and visualisation within these programs is limited. Within these limitations I have used MATLAB as the data storage and processing software.

The data obtained from the Census Interaction Dataset is visualised in the probability density graphs in Figs. 1 and 2. The graphs are composed of two functions, the first function with origin at x = 0 km (in red and magenta), depicts the average commuting distance by destination ward. Within the same graphs there is a second function (in blue and cyan) which is a probability density function for average commuting distance by ward of origin. This second function has origin at x = 17.71 km as this is the distance that appears with the highest probability among the geographic distance between wards. Since the commuting direction for the journey from and to work is reversed, the functions have also been reversed to reflect the flows in both directions. The figures between the 1981 and 2001 charts are projections of the two graphs on an hypothetical settlement plan. These projections represents the labour sheds (in red and magenta), which are formed by the average commuting distances by destination ward and the employment fields (in blue and cyan) that comprise the average commuting distances by ward of origin. The radiuses of circles are drawn at the commuting distances with the highest probability ('mode') to effectively show the boundaries of the settlements for the years 1981 and 2001.

3. APPLICATION AND RESULTS

Fig. 1 and 2 show the probability density graphs for England and Wales for average commuting distance for male and female commuters. In both graphs origin and destination probability densities have shifted towards each other demonstrating that the average commuting distances have increased.

By dividing functional regions by gender it is possible to determine how gender roles within the labour force are affecting settlement patterns. Both in 1981 and 2001 men tended to commute longer distances from home, almost double the distance of women. Employers sought male workers at farther distances than female workers. Men were willing to live at longer distances from work compared to women. However this gap was reduced in 2001, when the difference between longer distance commutes from home were reduced. There was an increase in average commuting distances for both genders, though it was much more noticeable in women. The disaggregate figures for average commuting for men and women demonstrate that they tend to make different decisions on how far they prefer to live from their work and these decisions change over time within separate dynamics.

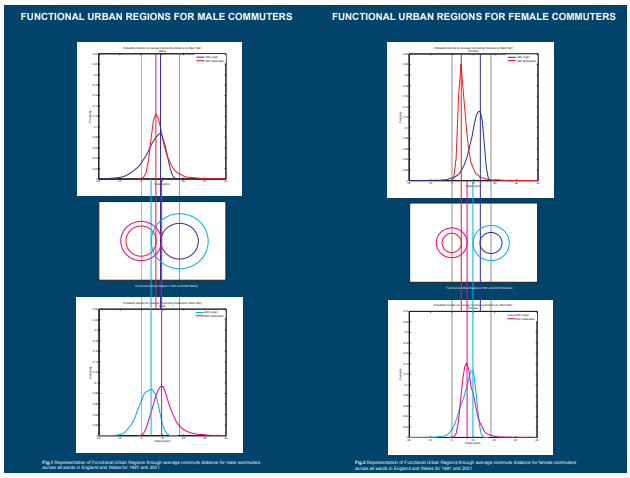

Fig 1 Fig 2

4. CONCLUDING REMARKS

The visual representation of the whole range of commuting distances across England and Wales and the schematic representation of the respective Functional Regions that they delineate provides a strong basis for understanding settlement patterns and how they change over time. By disaggregating this information by gender it is also possible to provide a striking contrast between commuting preferences between these two commuter groups.

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