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Ripples and undulations in the perceived supply–demand mismatch surfaces of London's job market

Yao Shen [a] and Michael Batty [b]

ABSTRACT

In all cities there is a potential for a mismatch to occur between the demand for and supply of jobs. This mismatch is reflective of the balance struck between jobs and housing. This mismatch is non-uniformly perceived by different occupations. The present paper introduces a method to simulate and represent the mismatch surfaces in the perceptions of different social groups that can be compared through visualization using a standard balanced plane. The three-dimensional visualization of the results of the London metropolitan area demonstrates that the commuting advantages – higher levels of commuting affordability through various transport systems, and the configuration of the land-use system – lead to larger 'flooded areas' under the balanced plane ($S_i^m = 0$) and a more scattered pattern of the job centres from the central city to suburban areas for people in higher managerial occupations. Evaluation of these surfaces further show the east–south and north–south divisions perceived by occupations.

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transport; supply–demand mismatch; accessibility; three-dimensional visualization; spatial interaction; job market

The potential mismatch between the demand for jobs that residents generate and the location of these jobs implies the degree to which the system is out of equilibrium with respect to its labour and housing markets (Batty, 2005; Kain, 1992). Existing efforts made to estimate the mismatch have used aggregated data with an unverified assumption that our perceptions about this mismatch have no difference across different social groups. This study measures, visualizes and then compares the mismatch landscapes perceived by occupations in the London Metropolitan Area (LMA). It suggests the necessity of addressing the perceptual variance of the supply–demand mismatch in relevant spatial analyses of the job market.

First, we use a logarithmic transformation to enable an index to represent the mismatch between job supply as observed and the demand for jobs using a residential location model that simulates the journey to work from a residential location to any job location, where the attraction of the job location is measured not by the jobs but by the population at that job

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location. This is:

$$S_i^m = \log\left(\frac{o_i^m}{d_i^m}\right) = \log\left(\frac{o_i^m}{G^m \times z_i^m}\right) = \log\left(\frac{O_i^m}{G^m \times \sum_j \sum_l P_{ji}^{lm} R_j^{lm} W_{ij}^{lm}}\right) \quad (1)$$

Here the mismatch index is a straightforward ratio of these two quantities: the number of jobs of type m supplied in zone i is o_i^m; and the number of jobs demanded by the population at the same locations is d_i^m. When $o_i^m > d_i^m$, the index is positive; and when $o_i^m < d_i^m$ it is negative. The jobs o_i^m are those that are observed, but the demand, d_i^m, is simulated using a singly constrained gravity model of the variety first defined by Huff (1963) and, thence, elaborated as a residential location model by Wilson (1969). G^m is a constant for normalizing the simulated demand z_i^m by ensuring that the total demand is the same as the total supply. Based on this, we can expect a balanced plane ($S_i^m = 0$) could exist. z_i^m is quantified by combining the reachable residents, R_j^{lm}, with an universal inverse function of travel time, W_{ij}^{lm}, and a selection probability, P_{ji}^{lm}, which are calibrated by the doubly constrained spatial interaction model (Wilson, 1969) and the Huff model, respectively.

The mismatch scores are interpolated by the Kriging method for each National Statistics Socio-economic Classification (NS-SeC) occupation on the spatial lattice that covers the London region and then the generated three-dimensional interactive surface plots are shown in Figures 1 and 2. The public/private transport systems are built from travel-time matrices

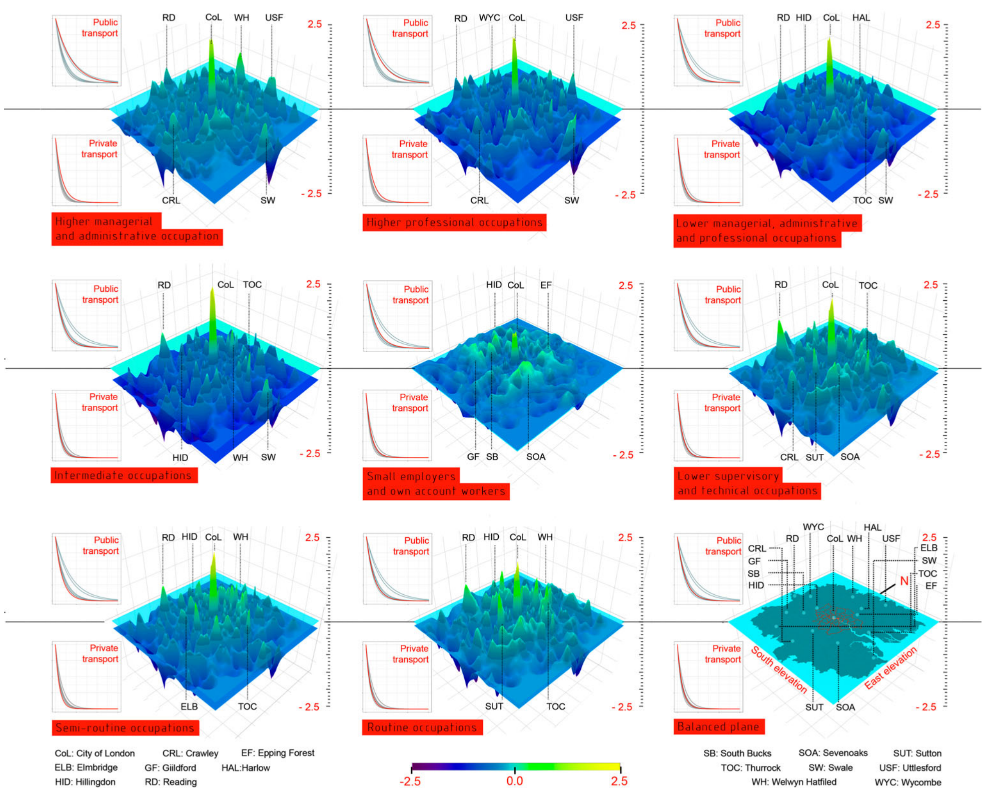

Figure 1. Three-dimensional surfaces of the normalized supply–demand mismatch scores for commuters in different occupational groups through the public and private transport networks. Calibrated exponential distance decay curves are also fitted.

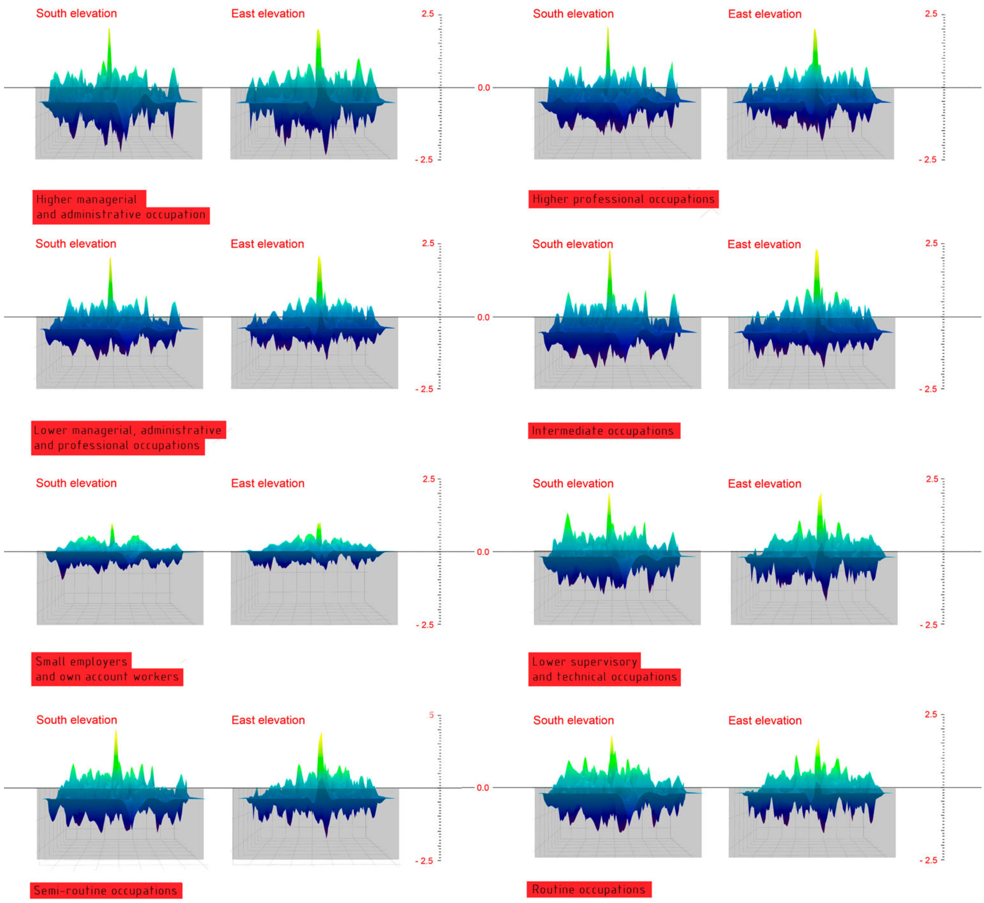

Figure 2. Elevations of the normalized supply–demand mismatch surface scores for commuters in different occupational groups through the public and private transport networks.

using average travel speeds as entries. The disaggregated commuting flow data sets on the middle layer super output area (MSOA) level are used as the input in this model.

Figure 1 shows the normalized mismatch surfaces with a standard altitude ranging between –2.5 and 2.5 for eight NS-SeC occupational groups, revealing how the urban spatial structure can vary between the perceptions of different groups of people. It is recognized that the differentiation of transport affordability across occupations is significant. The distance-decay parameters for the groups positioned higher in the occupational hierarchy are higher than others ranked lower. These commuting advantages and the spatial configuration of the land-use system lead to larger 'flooded areas' under the balanced plane ($S_i^m = 0$) and more scattered patterns of the job centres from the central city to suburban areas for people in higher occupations. The undulation of the mismatch surface for the small employers is the smallest with a mean plane greater than zero. Main job centres are highlighted as various peaks in the mismatch surfaces with higher levels of job provision than other places. The City of London and Westminster and other major job clusters, such as Reading, Hillingdon and Thurrock, for example, are still positioned at the top for most groups of people, although their dominant roles are far more obvious for the groups in higher occupations.

Figure 2 provides a series of elevation views of the mismatch surfaces from the north and east, which complements the three-dimensional visualizations with cameras located from a fixed angle. These elevations first look at the surfaces under the 'sea', illustrating that the mismatch of the higher occupations is more significant than that of the lower occupations. The south sections of the mismatch surfaces capture the east–west division in the LMA. For all the groups, there are 'sinks' in east London where fewer competitive job centres with sufficient job provisions are located. Similarly, the east sections illustrate a decay of the mismatch score from the north to the south.

Uncovering the non-equilibrium of the job market is essential for understanding social inequality, residential segregation, excessive commuting and related spatial variations. Equipped with the method and the cartographic conventions introduced, we can easily compare and interpret the supply–demand mismatch landscapes in the perceptions of job seekers across social groups, as well as assess the functionality of relevant policy implementations comprehensively.

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