The Urban Freight Landscape Atlas

Project Number: 1B
Year:2013

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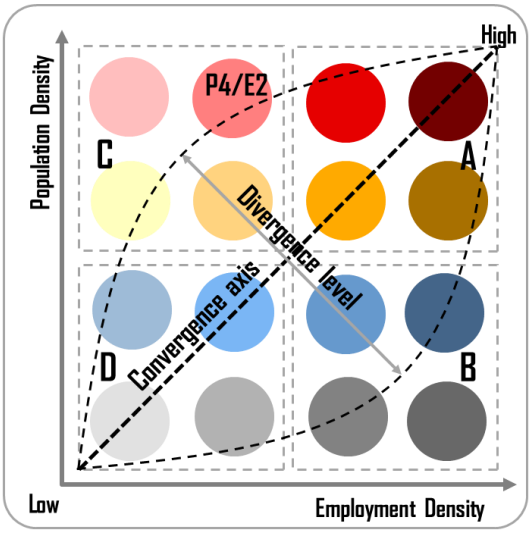
Abstract

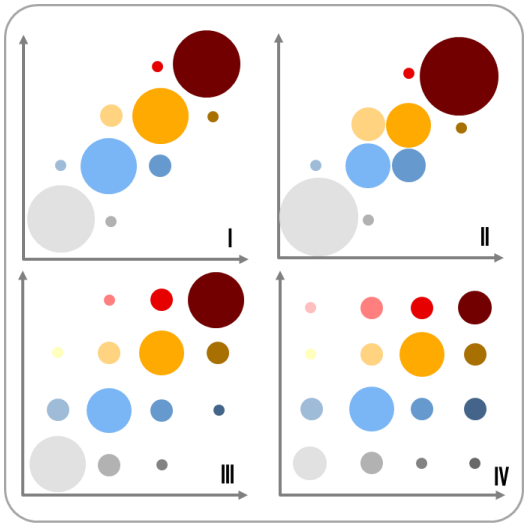
Mapping of the urban freight landscape: the spatial distribution of freight activity and intensity in a metropolitan area. Using population and employment density information, a freight landscape matrix is calculated for four major metropolitan areas: New York, Los Angeles, Paris and Seoul. Levels of convergence and divergence between population and employment densities are assessed, each characterized by different freight landscapes requiring different city logistics strategies. Results reveal substantial variations between metropolitan areas, which are observed across the respective levels of zonal specialization as well as density changes over distance from central areas.

Assessing the Freight Landscape

The freight landscape is represented as a **density matrix** that cross-references population and employment densities for spatial units (per square km), both of which are associated with freight generation and attraction. Population and employment data are classified in four classes using the quantile method. Each density class is assigned a simple label: Population (P1 to P4) and Employment (E1 to E4), with classes ordered from lowest to highest. Density classes are then cross-referenced with the distribution of the density among classes reflective of a **pattern**.



Quadrant A (High density convergence). Commercial and financial districts where retail and service activities are related to high employment densities.
Quadrant B (Employment-based divergence). Manufacturing and warehousing districts with high employment densities; transport terminals such as warehouse clusters, airports, ports and rail yards.
Quadrant C (Population-based divergence). Specialized residential districts (often planned) with



Pattern I (High convergence). Mixed urban land use zones that are dominant since the great majority of the spatial units have their population density correlated with their employment density.
Pattern II (Significant Convergence). Some level of specialization, particularly at mid-level densities. Commercial sub centers as well as areas having specialized manufacturing and distribution activities.
Pattern III (Limited Convergence). More diverse structure with a range of specialized urban zones. This

lower employment levels, focusing on retail logistics and home deliveries.
Quadrant D (Low density convergence). Various forms of peri-urban and suburban activities, which are usually a mix of low density residential areas, malls and some light manufacturing or distribution clusters.

implies a large array of urban distribution systems with notable areas of retailing, manufacturing and distribution specializations.
Pattern IV (Divergence). Highly specialized urban zones with high population density areas generally separated from high employment density areas.

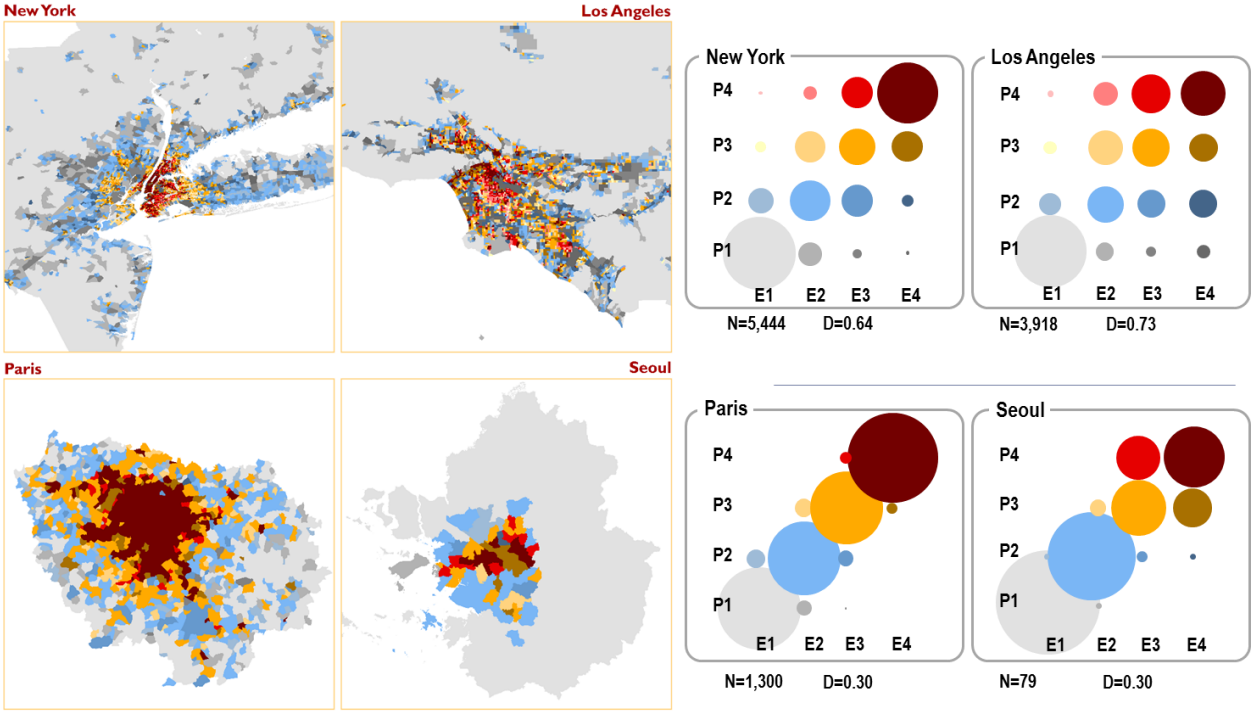
Divergence index (D):

$$D = 1 - \sum_{1}^{N} \frac{|C_N - C|}{S} \Big/ 1.5$$

Where N is the number of cells in the density matrix (16 in the 4x4 matrix used in this analysis), S is the total number of spatial units, CN is the number of spatial units in cell N and C is the number of spatial units per cell if each cell had the same number of spatial units (uniform distribution). An index of 0 would imply a complete convergence (all the observations are along the convergence axis) while an index of 1 would imply a functional divergence (all the cells have the same number of spatial units).

The Freight Landscape: Convergence and Divergence

Results were compiled for four metropolitan areas. The left side depicts the spatial distribution of the density matrix according to what category (cell) each spatial units belongs to. The right side shows the functional distribution of the respective density matrices; the larger the circles, the larger the share of the cells they represent in the freight landscape.



The results show an impressive diversity of freight landscapes in terms of the spatial and functional distributions. The largest number of spatial units of each metropolitan area are almost exclusively in the low population and employment density category (P1/E1). These units are also of larger size with a greater probability of a mix of activities, including rural. This suggests that a substantial part of these metropolitan areas is comprised of areas that have limited levels of city logistics activities, or at least few constraints to freight distribution activities. As expected, Los Angeles has the highest level of divergence in its freight landscape (D=0.73), followed by New York (D=0.64). Although Paris and Seoul have the same divergence index (D=0.30), Seoul's level of divergence is likely to be higher due to the limited number of spatial units that were considered in this assessment.