



Tracking Logistics Locations – Distance-based methods for relative industrial concentration measurement applied to the region of Berlin-Brandenburg

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Abstract. The paper analyses the phenomenon of suburban concentration in connection with the spatial deconcentration of logistics locations in urban areas. By this we are adding further analysis to the concept of logistics sprawl. For the region of Berlin-Brandenburg we can show that apart from the sprawl of logistics locations there is a concentration of these locations in suburban regions. We applied classical concentration measures on data of companies in the WZ-2008 group 52.1 Warehousing and storage. Medium-sized logistic companies are relatively more common than within the overall economy. There are relatively less small logistics companies. In addition, large logistics companies are significantly more frequent in the suburbs of Berlin. This may indicate a fundamental structural difference of the logistics branch that is common to all regions, accompanied by a superimposed concentration pattern which is specific to the suburbs. The concentration of these logistics locations is higher in the surrounding area of Berlin than in Berlin itself as well as in other areas of Brandenburg. Analysis of these logistics locations by Kernel density analysis revealed hotspots of the concentration around the City of Berlin in the suburban region of Brandenburg, dominated by a cluster in the south of Berlin.

1 Introduction

The analysis of changes in logistics location patterns is often connected to the term logistics sprawl. In general logistics sprawl is defined as “the historical trend towards spatial deconcentration of logistics terminals in metropolitan areas” [1]. It is seen as the sprawl of logistics locations from the city centre to outer areas of the city. The effects of logistics sprawls are seen as important factors in the change of transportation patterns in urban agglomerations. Logistics sprawl, its effects and causes were analysed in different regions of the world with central spots in the US, in Europe and recently in Japan [2].

Additional to the effect of logistics sprawl the effect of logistics suburbanization is recently discussed in the literature [3]. It is described as the

transformation of low density suburbs and the integration of logistics in the outskirts of metropolitan areas.

Apart from the above mentioned sprawl of logistics locations from the city centre and the effect of logistics suburbanization, there may be further effects which lead to concentration of logistics at certain points – mostly in suburban regions of cities. In our paper we aim to track this phenomenon of suburban concentration. The objective of this paper is to detect concentration patterns of logistics locations in the region of Berlin-Brandenburg.

2 Data and methodology

For the analysis of the phenomenon of suburban concentration in connection with the spatial deconcentration of logistics locations in urban areas

we use data of warehouse locations in the region of Berlin-Brandenburg. The data are publicly available from the German business register for Berlin and Brandenburg for the years 2006 to 2013. Companies in the business register are classified according to the *Klassifikation der Wirtschaftszweige, Ausgabe 2008 (WZ 2008)*; Classification of Economic Activities, edition 2008 (WZ 2008) which is based on the *Nomenclature statistique des activités économiques dans la Communauté européenne (NACE, Revision 2)* [4]. For our analysis companies classified as group 52.1 (Warehousing and storage) were chosen as relevant. The data are subdivided by municipalities as spatial unit. In Brandenburg there are 418 municipalities. In Berlin the data are subdivided by 12 districts. Companies in the business register are grouped into four economic size classes.

We first applied classical methods of concentration measurement to the data. To reveal general structural differences, the data were spatially aggregated into 3 areal classes (City of Berlin, suburban regions of Brandenburg, and rural areas of Brandenburg). All municipalities in Brandenburg which belong to the Metropolitan area Berlin-Brandenburg were classified as suburban regions of Brandenburg. Other regions of Brandenburg have been classified as rural areas (see Figure 1).

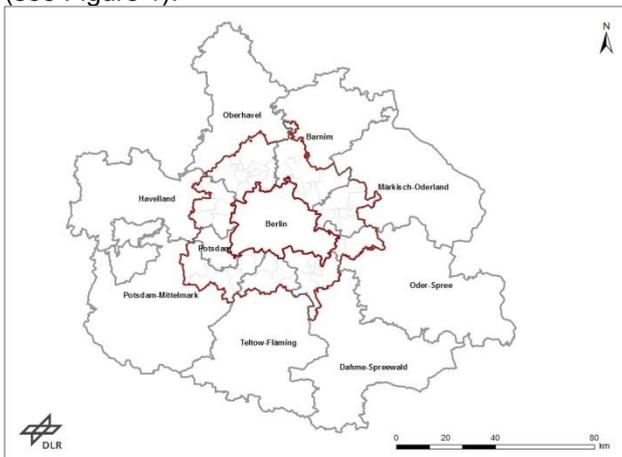


Figure 1. Area of analysis.

Classical methods such as the Gini coefficient have emerged from a long tradition of geographical pattern analysis and are still in use in combination with modern measures [5]. But they do not allow for the exact examination of spatial patterns due to their high information aggregation and the Modifiable Areal Unit Problem (MAUP) [6].

To detect local concentrations of logistics companies we will use a Non-parametric Multivariate Kernel Density Estimation (MKDE) with data-driven kernel selection and an automated bandwidth selection as distance-based method. Data used from the German business register for Berlin and Brandenburg states the municipality and not exact addresses of company locations. Therefore the model is not used at full capacity, but

still works on the community centroids providing the least aggregation level possible with a given basis of data. Visual presentation of the results of the analysis will show centres of concentration of logistics companies in the suburban regions of Brandenburg.

3 Results

Table 1 shows the number of companies in WZ-2008 group 52.1 (Warehousing and storage) in the respective area of analysis. For comparison, Table 2 shows the distribution of all companies in the same area.

Table 1. Companies in WZ-2008 group 52.1 by employee size classes, year 2013.

	0-9 empl.	10-50 empl.	More than 50 empl.
Berlin	36	11	2
Suburb	38	15	11
Rural	37	9	3

Table 2. Companies in all WZ-2008 groups by employee size classes, year 2013.

	0-9 empl.	10-50 empl.	More than 50 empl.
Berlin	158,698	12,322	3,444
Suburb	38,285	3,429	876
Rural	58,763	5,987	1,444

Homogeneity testing shows statistically significant differences in relative frequencies of specific company sizes. Among all 3 areas, medium-sized logistic companies (10-50 employees) are relatively more common than within the overall economy. Consequently, there are relatively less small logistics companies (1-9 employees), compared to the economy in total. In addition, large logistics companies (50+ employees) are significantly more frequent in the suburbs. This may indicate a fundamental structural difference of the logistics branch that is common to all regions, accompanied by a superimposed concentration pattern which is specific to the suburbs. For additional investigation, further location data is included in order to reveal more details about such concentration patterns and their development.

A basic data analysis with classical methods of concentration measurement shows a higher concentration of warehouse locations in Brandenburg than the general, overall concentration

of all companies. Table 3 gives results of the concentration analysis of WZ-2008 group 52.1 compared to all companies in Brandenburg (suburb and rural combined). Such data does not provide any information about the specific location of the concentration.

Table 3. Concentration indices for Brandenburg, year 2013.

	WZ-2008 52.1	All companies
Gini coefficient	0.9607	0.7429
Theil index	1.1803	1.1727
Entropy index	2.8586	1.0979

The further application of classical concentration measures on municipalities in Brandenburg which belong to the Metropolitan area Berlin-Brandenburg in comparison to the rest of Brandenburg shows, that there is a much higher concentration of warehouses relative to all companies of the general economy (see Table 4).

Table 4. Concentration indices for suburb and rural areas in Brandenburg, WZ-2008 group 52.1, year 2013.

	Suburb	Rural	Berlin
Gini coefficient	0.8504	0.9591	0.6430
Theil index	0.8831	0.8737	0.6586
Entropy index	1.8760	2.9236	0.8278

Yet further analysis on more detailed geographical location information appears to be inevitable for proper concentration detection and modelling. The application of MKDE as distance-based method on the data for group 52.1 companies visually reveals the locations of concentration of logistics companies in Berlin and Brandenburg. Figure 2 shows concentration hotspots inside and around the City of Berlin in the suburban region of Brandenburg, dominated by a large cluster in the south of Berlin. Smaller hotspots have been detected close to cities of the rural surrounding area, which nonetheless shows no existing logistics activities for the most part of its large area.

4 Conclusions

Data analysis of warehouse locations in the region of Berlin-Brandenburg from publicly available data from the German business register for Berlin and Brandenburg shows that there is a concentration of logistics companies in suburban

areas of Brandenburg, which surround the City of Berlin. There are relative more logistics companies than other companies in this area. When taking the size of the area into account this relative concentration is even more obvious. The application of concentration indices shows that there is not only a relative concentration but also a difference in concentration patterns.

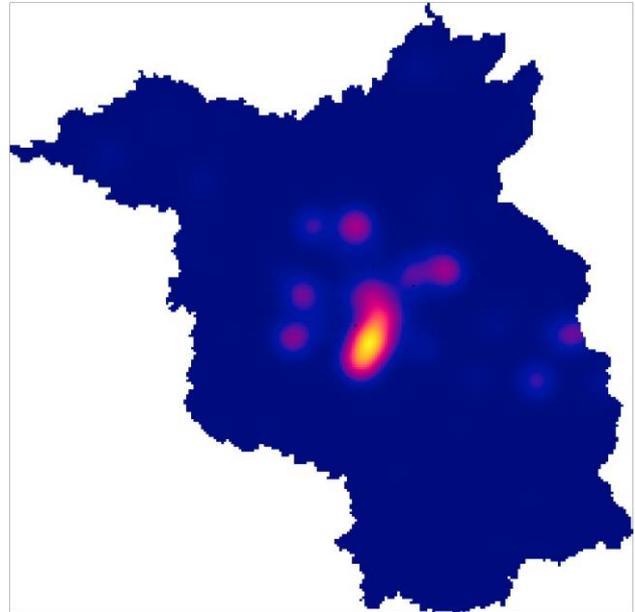


Figure 2. KDE of WZ-2008 group 52.1, year 2013.

The interpretation of Gini coefficient, Theil index and Entropy index show specific concentrations in the suburban area of Brandenburg. It is useful to take all three measures into account as each of them has some drawbacks. The Gini coefficient for instance shows higher values for the rural areas of Brandenburg than for the suburban areas. This is due to the high number of municipalities in the rural areas (367) compared to the smaller number of municipalities in suburban areas (51).

As the application of classical concentration measures did not reveal the patterns of the concentration, distance based methods were applied. This has shown that the concentration of logistics locations is distributed diversely among Berlin and its surrounding areas. Visual interpretation of the results of the analysis allows the conclusion that hotspots of warehouses in the area of Berlin and Brandenburg are in the close proximity to Berlin and in the suburban areas of Brandenburg.

The presented method provides a practical and comparable tool for the examination of logistics locations and their concentration pattern. According to the results a logistics sprawl is not only characterized by sprawl to areas outside cities and a deconcentration, but far more so by the increasing concentration at specific locations in the metropolitan periphery. The resulting concentration differs from those of the overall economy.

In order to further reveal relative concentration patterns, employees of logistics companies can be

put in direct relation to the general employment. Furthermore resulting relative KDE-patterns should be analysed over time. This will be part of further research.

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