Mapping warehouses and assessing their socioeconomic impacts in France with a focus on e-commerce activities

Author: Mohammed Younes
Institution: University of Lille – Polytech Lille, Master of Urban Engineering and Habitat
Hosting Institution: Laboratoire Ville Mobilité Transport (LVMT) – Gustave Eiffel University
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Supervisors: Dr Laetitia Dablanc, Dr Marion Albertelli, Dr Matthieu Schorung, and Dr Ammar Aljer

Abstract

This Master's thesis explores the spatial and technical methods used to identify the accurate locations of warehouses in France, alongside the factors influencing the location selection of e-commerce warehouses. It also focuses on studying and understanding the complex relationships between urbanization, infrastructure, and economic conditions. This study also uses spatial analysis methods to investigate the impact of different socioeconomic variables on the density of ecommerce warehouses. The results show that urbanization and transport networks, particularly road infrastructure, are key determinants of warehouse location selection. Socioeconomic factors, such as income and employment, also play an important role, with warehouses more frequently located in lower-income, industrial regions. The findings contribute to the broader understanding of e-commerce logistics and offer valuable insights for improving warehouse location analysis through the integration of real-time data and advanced spatial econometric techniques.

Research objectives

The research aims to address key questions on the spatial distribution of e-commerce warehouses in France, considering the following objectives:

1. Critique and evaluate current methodologies for location identification for logistics facilities, introducing alternative approaches to overcome data and methodological limitations.
2. Identify the primary factors influencing the location of warehouses, particularly for e-commerce.
3. Statistically analyse the socioeconomic impacts of these facilities, including job creation, local economic shifts, and potential environmental effects.

Literature review

The report first examines existing literature on warehouse location theories, logistics sprawl, and the impacts of e-commerce on urban logistics and communities. Previous studies indicate that traditional methods for identifying logistics facilities are limited by difficulties to retrieve accurate or complete data, and static socioeconomic spatial units that fail to capture dynamic logistics needs. This thesis extends the literature by focusing on the unique spatial demands of e-commerce logistics and the social and economic dimensions often overlooked in traditional analyses.

Methodology

The study employs a multi-method approach to locate and analyse warehouse facilities in France:

1. **Data collection**: A database was created from various sources, including the SIRENE (establishments) and SITADEL (building permits) databases, OpenStreetMap, and manual data collection. The dataset includes geographic locations of the warehouses and different related indicators.

2. Spatial analysis: Using GIS and statistical methods and based on data availability, the data were examined at the Urban Attraction Areas ("*Aires d'Attraction des Villes*" (AAV)) scale, a geographic unit offering more accuracy for regional analysis than traditional administrative boundaries.
3. Statistical techniques: Multiple Linear Regression (MLR) and Principal Component Analysis (PCA) were used to identify correlations between warehouse locations and socioeconomic factors, with attention to factors such as income, employment, and transportation.

Key findings

1. Limitations of current identification methods: The research critiques common methodologies for warehouse location identification, particularly those relying on administrative boundaries. The study proposes alternative approaches, using the available open data sources, to improve data accuracy and represent dynamic logistics environments.
2. Spatial distribution: The study found that e-commerce warehouses are more likely to be located in urban and sub-urban areas with strong transport links and affordable land. Urbanisation and road infrastructure are significant determinants, with higher densities of warehouses observed in regions where these factors align.
3. Socioeconomic impacts: Warehouses contribute to job creation, particularly in industrial regions with lower-income levels, though often at the expense of environmental quality due to increased traffic and emissions. The data suggest that while logistics facilities may stimulate local economies, they also bring challenges that disproportionately affect lower-income neighbourhoods.

Figure 1 shows the spatial distribution of the e-commerce warehouses in France, which were collected manually during the research. Figure 2 shows the results of the PCA analysis, which simplifies complex data by summarising it into two main dimensions (Dim1 and Dim2) that explain the most significant patterns in the dataset. The elements shown in the graph allow us to understand how different factors contribute to broader trends within the data. Finally, the colours group factors that share similar characteristics or behaviours.

Conclusion and recommendations

The report concludes that the spatial distribution of e-commerce warehouses is driven by a combination of economic, spatial, and social factors, with location choices often balancing operational efficiency with socioeconomic considerations. The research recommendations include:

- Implementing more nuanced spatial analysis techniques in logistics research to better capture the effects of logistics sprawl.
- Enhancing policy frameworks to mitigate the environmental and social costs of logistics facilities, especially in low-income areas.
- Encouraging the development of open-source, real-time databases for more accurate and timely spatial data on logistics activities.

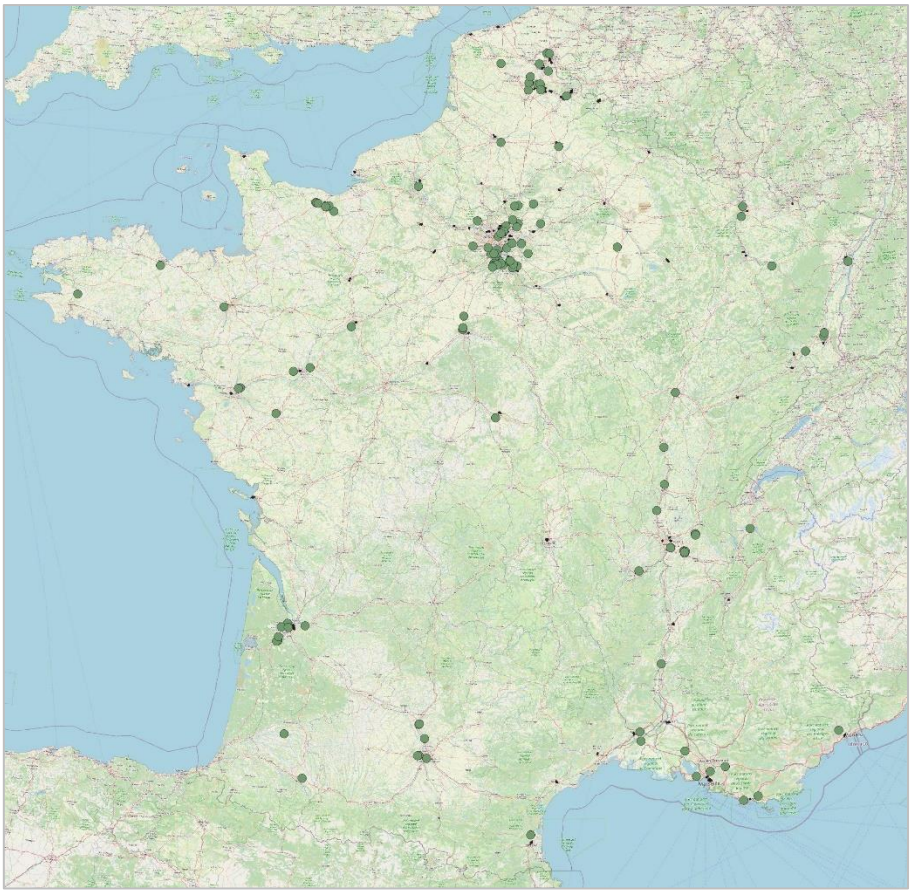

Figure 1: The distribution of e-commerce warehouses in France. Younes, 2024.

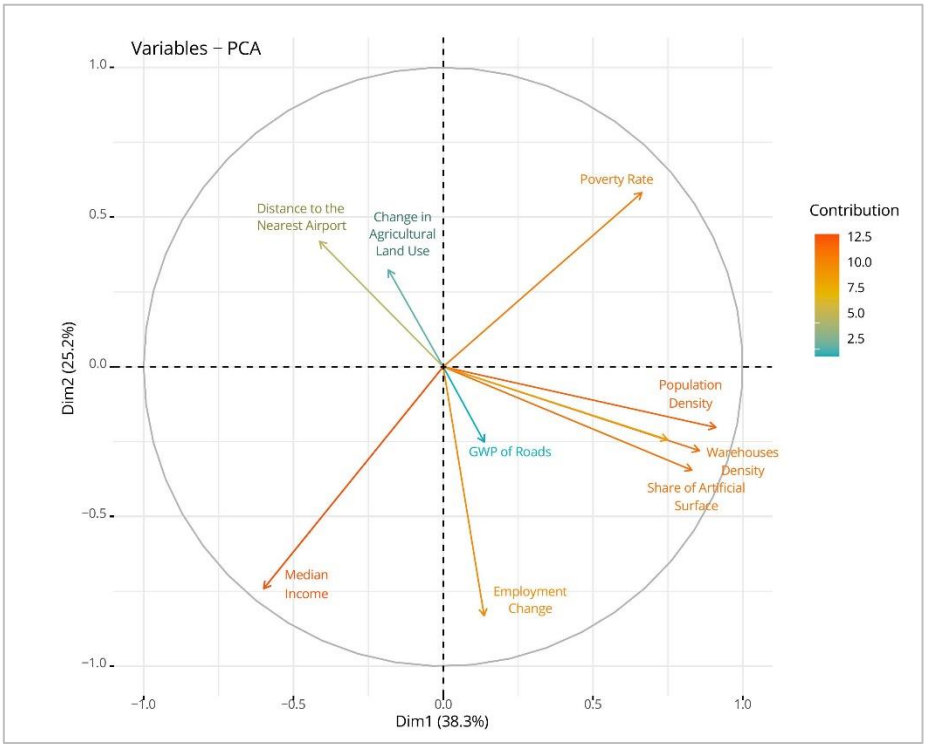

Figure 2: The results from the PCA analysis of socioeconomic and environmental indicators. Younes, 2024.