Logistics Sprawl: Differential Warehousing Development Patterns in Los Angeles, California, and Seattle, Washington

Laetitia Dablanc, Scott Ogilvie, Anne Goodchild

Logistics Sprawl: Differential Warehousing Development Patterns in Los Angeles and Seattle

July 30, 2013

7326 words

Laetitia Dablanc
Director of Research
IFSTTAR, University of Paris-Est

(+33 1 81 66 87 78)
University Paris-Est, IFSTTAR, SPLOTT
14-20 boulevard Newton, Cite Descartes
77447 Marne la Vallee cedex 2, France

Scott Ogilvie
Graduate Research Assistant
Civil and Environmental Engineering
University of Washington

(847)-452-3562
1259 Sunny Court # 14
San Jose, CA 95116

Anne Goodchild
Associate Professor
Civil and Environmental Engineering
University of Washington

(206) 543 3747
121E More Hall, Box 352700
University of Washington
Seattle, WA 98195-2700

ABSTRACT

The warehousing industry experienced a period of rapid growth from 1998 to 2009. This paper compares how the geographic distribution of warehouses changed in both the Los Angeles and Seattle Metropolitan Areas over that time period. These two west coast cities were chosen due to their geographic spread and proximity to major ports as well as their difference in size. The phenomenon of logistics sprawl, or the movement of logistics facilities away from urban centers, which has been demonstrated in past research for the Atlanta and Paris regions, is examined for these two areas. The weighted geometric center of warehousing establishments was calculated for both areas for both years, along with the change in the average distance of warehouses to that center, an indicator of sprawl. We find that between 1998 and 2009, warehousing in Los Angeles sprawled considerably, with the average distance increasing from 25.91 to 31.96 miles, an increase of over 6 miles. However in Seattle, the region remained relatively stable, showing a slight decrease in average distance from the geographic center. Possible explanations for this difference are discussed.

INTRODUCTION

Starting in the 1990˘s the logistics industry began experiencing rapid growth. This was reflected by warehousing specifically, which for the purposes of this paper is defined as any industry falling under North American Industry Classification System (NAICS) Code 493 ¯ Warehousing and Storage. This includes general, refrigerated, farm product, and other warehousing and storage. (Code 493 has kept the same definition over our study period, eliminating possible bias in comparing different years). Across the United States, employment in the warehousing industry increased by almost 400% between 1998 and 2006 at a compound annual growth rate of 22.25%, compared to total U.S. employment which grew by 1.3% annually (1). The number of warehousing establishments more than doubled from 6,712 in 1998 to over 14,000 by 2008 (2). The trend continued until the recession, at which point the growth in the warehousing industry began to slow. The number of warehousing establishments increased every year through 2007, at which point there was a 1% decrease in establishments in 2008. From 2008 to 2011 the number of establishments decreased at an average of 0.4% per year. Similarly the number of warehousing employees increased every year through 2008, at which point there was a 4% decrease in warehousing employment by 2009, and a further 3% decrease in 2010, before increasing less than a percent in 2011 (3). This paper will compare the locations of warehouses in two major population centers on the west coast ¯ Los Angeles and Seattle, during the growth period. These two cities can be compared to Atlanta, for which a similar analysis was completed in Dablanc and Ross (2012) (4).

Specifically, this paper will focus on a phenomenon known as logistics sprawl, which is the tendency of warehouses to move away from urban regions toward more suburban and exurban areas (4). Dablanc and Ross show this phenomenon to be occurring in the Atlanta area, which has a metropolitan population of approximately 5.5 million people (5).

The Seattle area studied is smaller than Atlanta˘s, with a population of 3.5 million, while the Greater Los Angeles area is much larger at approximately 18 million (5). Both Seattle and Los Angeles are located next to the Pacific Ocean, and house major intermodal terminals, including the 1st and 3rd largest container terminal complexes in the United States, respectively. This creates demand for warehouses in the nearby area. Geographic features such as the Pacific and mountain ranges constrain both regions geographically (but in diverse ways), influencing urban expansion patterns.

The LA area used in this study (commonly referred to as the Greater Los Angeles area) includes Ventura, Los Angeles, Orange, San Bernardino, and Riverside counties, shown in **Figure 1**. Los Angeles is bordered to the southwest by the Pacific Ocean, and is separated from much of northern LA and San Bernardino counties by the San Gabriel Mountains to the north. There are also several smaller mountain ranges in the area, recent expansion of both population and industry has been largely to the east.

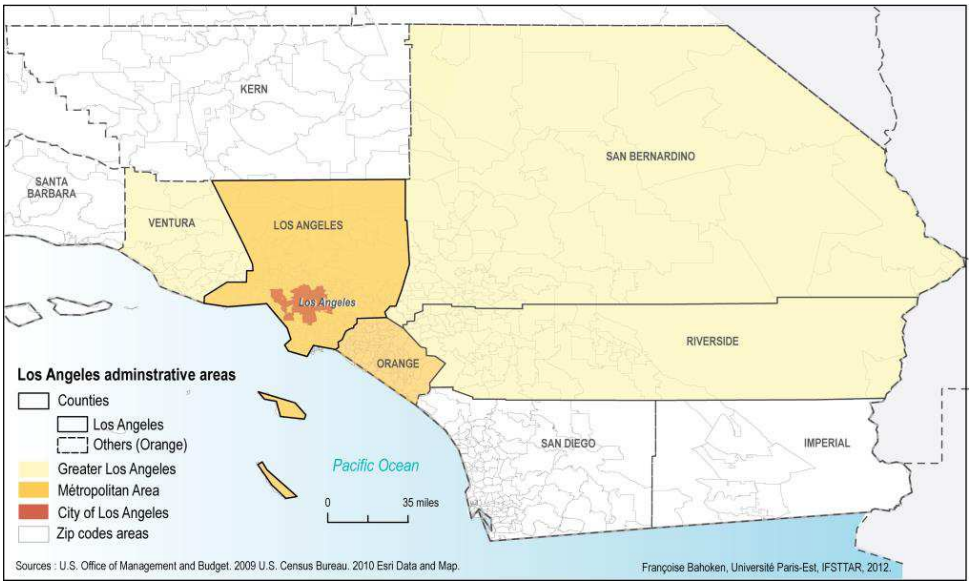

FIGURE 1 Los Angeles study area.

The Seattle-area counties studied were King, Snohomish, Pierce, Kitsap, and Thurston, stretching from Everett in the north to Olympia in the south, shown in **Figure 2**. The Puget Sound provides a geographic barrier to the west, and the Cascade Mountains border the east side of the urban region. There are a few residential and industrial areas to the west of the Sound, but most of the population and businesses are to its east. Transportation across the Sound is difficult as there is only one road crossing the body of water in the southern end and all other travel must be made by ferry. The vast majority of the population lives to the east of the water.

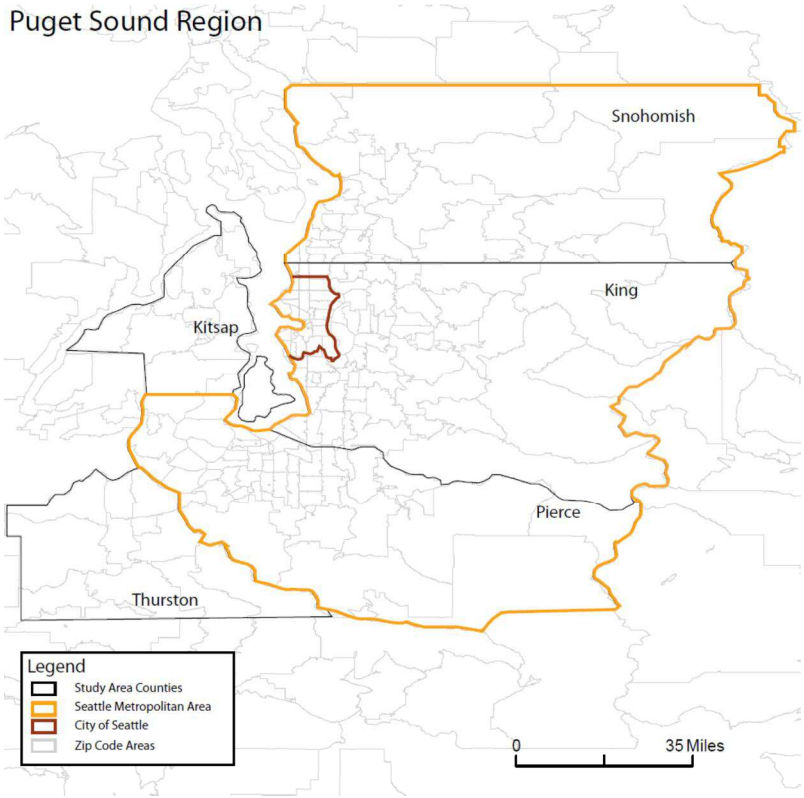

FIGURE 1 Seattle study area (Source: U.S. Census Bureau).

The Los Angeles Metropolitan Area economy grew from approximately $578 billion in real gross domestic product (GDP) in 2001 to $653 billion in 2009, a total growth of approximately 13% (6). The highest yearly GDP during that time period was $692 billion in 2008, which decreased by 5.6% in 2009. Major sectors in the Los Angeles economy include manufacturing, trade, and banking and finance. Transportation and warehousing comprise about 2.4% of total GDP (6).

The Seattle Metropolitan Area economy grew from approximately $173 billion real GDP in 2001 to $204 billion by 2009, a growth of approximately 18% (6). The highest yearly GDP during that time period was $211 million in 2008, which decreased by 3.3% in 2009. Major sectors include aerospace, information technology, trade, and tourism (7). Transportation and warehousing comprise about 2.9% of total GDP (6).

Trade is a major industry in both metropolitan areas. Transportation and warehousing make up a similar percentage of total GDP in both areas (2.4 and 2.9%). Most sectors in both regions experienced moderate growth until 2008 before declining due to the recession. However the Los Angeles Metropolitan Area experienced a greater percentage decline in GDP from 2008 to 2009.

LITERATURE REVIEW

Sivitadinou (1996) made one of the first empirical studies of the location of warehouses in a U.S. metropolitan area (Los Angeles) and examined its links with land prices (8), but her efforts were not followed by many others. `Urban economists have traditionally focused on the labor decisions of firms and households to try and account for various aspects of urban form. The location and transportation decisions made by the various entities in the supply chain as these parties manage logistics costs have received considerably less attention_ (9), while they have become increasingly more important, especially in metropolitan areas. The warehousing industry has undergone major restructuring, transforming it into a distribution industry serving major importers and big box retailers (10, 11), based on direct access to

consumption markets, globalized networks of goods distribution, hub and spoke networks and just-in-time operations. This has led to a rise in hub distribution centers (12). Very large distribution centers, or `mega DCs_ (1) have driven the early growth in warehousing establishments in metropolitan areas in the study period. Between 1998 and 2005, the number of distribution centers with more than 100 employees increased twice as fast as smaller facilities (1). Today˘s supply chains require a lot of logistics facilities, and the efficiency of goods distribution depends upon the optimal location and sizing of freight terminals. Freight transportation costs have decreased dramatically over the last thirty years (13). Low freight costs create an `increased locational flexibility_ (14) for freight and logistics facilities. The opportunity for good regional and national networking between facilities within a supply chain is a key factor (15). Finally, some warehousing activities which were previously performed as part of a manufacturing or distribution activity (and on the same premises), have been outsourced to logistics providers, automatically increasing the number of warehouses. In some cases manufacturers have implemented a specific warehousing/logistics facility when previously logistics functions (which required less space) were performed within the manufacturing facility itself (see the example of Vernon, in Southern California, presented in [16]). As noted by Hall and Hesse (2013), metropolitan areas retain logistics facilities because they have a sort of `freight advantage_ that includes `labour, skills, infrastructure, technology_ among others (17).

The new distribution centers required by the current organization of supply chains and a consumer-based economy are directly responsible for logistics sprawl, i.e. the tendency for warehouses to move from urban to suburban and exurban areas (4). Historically, warehouses and freight terminals have tended to be close to city centers and rail stations. Today, they need more space and are located as close as possible to highway networks and airports (18). Suburban areas are attractive because of the availability and low cost of land and also because of the availability of transportation infrastructure that connects to a more complex system of regional and national flows. This has an impact on urban landscapes by generating congestion, CO_2 emissions and local atmospheric pollution. These impacts are the result of additional vehicle-miles travelled (VMT) generated by the increase in distances travelled by trucks and vans to deliver commodities to urban areas where jobs and households remain concentrated. Dablanc and Rakotonarivo (2010) calculated that cross-dock terminals for parcel and express transport companies moved an average of 6 miles further away from the center of Paris between 1975 and 2008 (19). During the same period, jobs in general moved only 1.3 miles, meaning that logistics sprawl is much more prevalent than the general sprawl of economic activities in metropolitan areas. They estimated the net increase in annual CO_2 emissions resulting from the relocation of facilities serving the Paris region to be 16,500 tonnes in 2008 compared with 1974.

The issue of logistics sprawl has recently generated some discussion among scholars, particularly economic geographers. Cidell (2010) has shown that in 47 of the 50 large metropolitan areas she surveyed, `decentralization_ of freight activity had occurred over the last 20 years (1986-2005), as measured via Gini coefficients (20). Because data were processed at the county level, however, it was difficult to account for some of the relocation patterns, as central counties can be very widespread and changes in location within counties were not accounted for in Cidell˘s studies. Bowen (2008) confirms that logistics activities have experienced enormous, largely unnoticed, growth in recent years (15). He shows that the growth in warehousing was more marked in suburban counties than in central and rural counties: central city Metropolitan Statistical Area (MSA) counties saw warehousing establishments grow at an annual growth rate of 10.2%, while the increase for non-MSA counties and other MSA counties were respectively 9.3% and 11.8%. Hesse (2004), using two case studies from Germany, concludes that logistics activities favor distant locations for many reasons, some of which are specific to this industry while others apply to many economic sectors: overcoming congestion, planning requirements, or even the influence of unions (21). Looking at the Inland Empire in Southern California, De Lara (2013) emphasizes the role of temporary work availability and low-wage flexible workforce, demonstrating substantial wage differences in transportation and warehousing industries in L.A and Orange Counties compared with Riverside and San Bernardino Counties (22). These changes are embedded in a general transformation of the logistics real estate industry, increasingly dominated by global players organizing

large networks of distribution centers. Allen and Browne (2010) have found a tendency for warehousing to move away from urban areas to suburban areas in the United Kingdom and elsewhere in Europe. Land prices in Europe have been steadily increasing recently, so they theorize that this move has occurred partially due to cheaper land prices in suburban areas (23). The expansive roadway network in Europe allows companies to construct large warehouses in more centralized locations. In England specifically, they have found that warehousing districts are often strategically clustered along motorways close to, but just outside of large cities. While this is partly due to accessibility to the road network, it is also `a result of planning policy that encourages a concentration of such land use_ (23). We will come back to land use policies in the discussion of this paper.

DATA

The research described in this paper was conducted using zip-code level establishment data. Data for all establishments for the years 1998 and 2009 were downloaded from the County Business Patterns website (http://www.census.gov/econ/cbp/). Structured query language (SQL) was used to isolate establishments under NAICS code 493 specifically, and to aggregate establishment totals within a given region. The final data sets were all zip codes in Ventura, Los Angeles, Orange, San Bernardino, and Riverside counties in California and King, Pierce, Snohomish, Kitsap, and Thurston in Washington. ArcGIS software was used to create maps of warehouse and establishment data. Additionally the barycenter, or weighted geographic mean, was calculated and plotted for each region for each year using standard ArcGIS procedures. These procedures are discussed further in the results section.

LOS ANGELES RESULTS

In 1998, the bulk of the warehousing establishments in the Los Angeles Metropolitan Area were located in Southern Los Angeles County and east and south-east of downtown. **Erreur ! Source du renvoi introuvable.** shows the locations of distribution centers in the Los Angeles study area in 1998, displayed by zip code. The only zip code outside of LA County with more than 10 establishments is 91761 in Ontario, CA, which has 16 facilities listed under NAICS code 493.

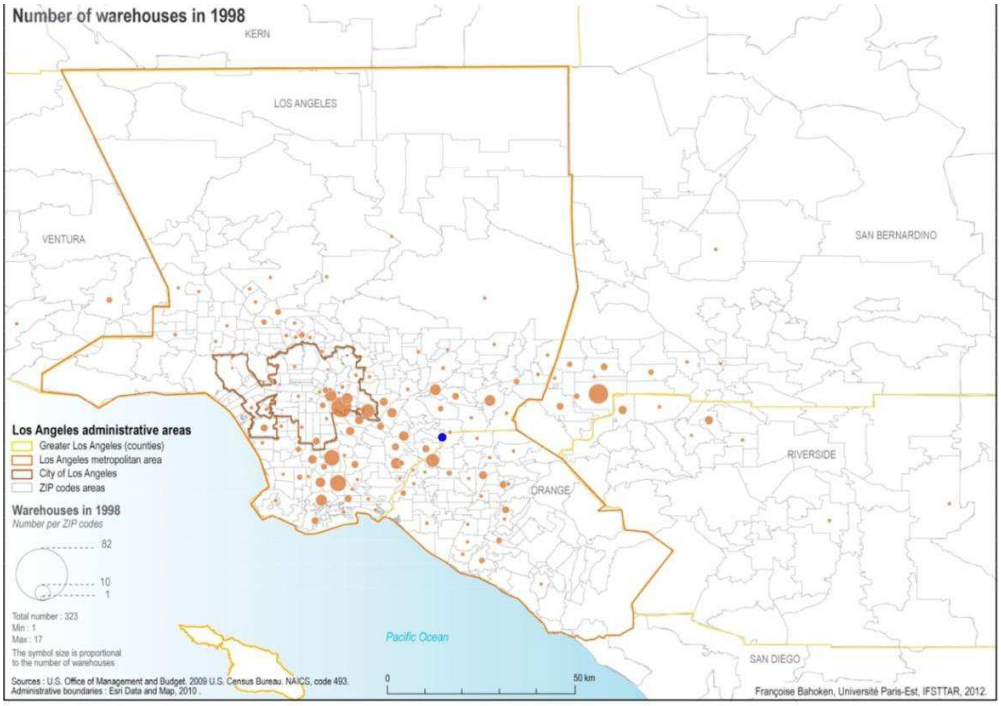

FIGURE 2 Los Angeles area warehousing, 1998. The weighted geographic center is indicated by a star.

By 2009, the warehousing industry had undergone a significant expansion, as shown in **Erreur ! Source du renvoi introuvable.**, below**.** The total number of warehousing establishments increased substantially, and two distinct concentrations of warehouses appeared ¯ one near the city of Los Angeles, and one around Ontario and zip code 91761.

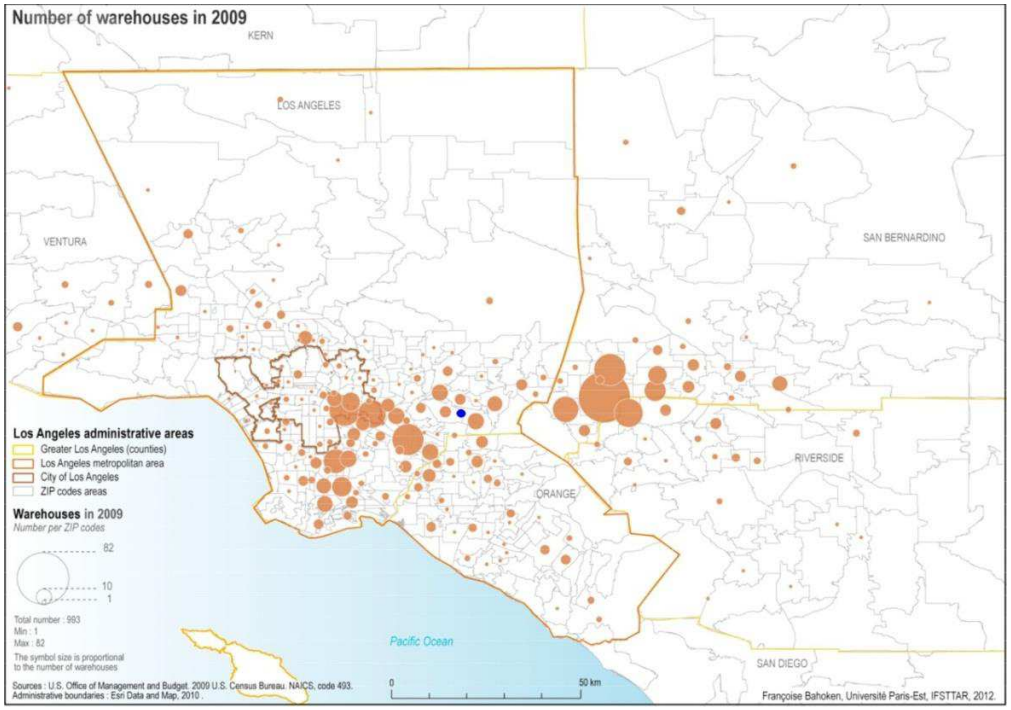

FIGURE 3 Los Angeles area warehousing, 2009. The weighted geographic center is indicated by a star.

There was moderate growth in both number of zip codes with warehousing establishments as well as total establishments within the city limits, shown in **Erreur ! Source du renvoi introuvable.** and **Erreur ! Source du renvoi introuvable..** Of zip codes with at least one establishment in 1998, 60 showed at least 100% increases in number of establishments. The number of establishments in Los Angeles County increased 134% from 220 in 1998 to 515 in 2009. Orange and Ventura counties experienced moderate growth. The most striking increase, however, appeared in western San Bernardino and Riverside counties, where in 1998 just one zip code had more than 10 establishments. As previously mentioned, this is centered around zip code 91761 in Ontario. The total establishments in San Bernardino County, for example, increased 641% from just 34 establishments in 1998 to 252 in 2009. Zip code 91761 increased from 16 establishments in 1998 to 82 in 2009. Several of the zip codes in the surrounding area also showed significant increases in number of establishments.

To quantify a potential shift in the location of warehousing establishments, a centrographic analysis of all establishments under NAICS code 493 was performed. The barycenter, or weighted geometric mean, of these was calculated for both years. The barycenter was weighted only by spatial distance; other warehouse characteristics, such as square footage or number of employees, were not included in the weighting. Then the distance from the barycenter to each establishment was calculated and averaged across all warehousing establishments. A similar analysis was done for all NAICS establishments. The findings can be summarized as follows:

- The average distance of warehousing establishments from their barycenter increased from 25.907 miles to 31.963 miles,
- but the average distance of all establishments from their barycenter remained stable, changing from 41.748 to 41.714 miles.

On the whole, there was very little change in distribution of all establishments, but warehousing has sprawled considerably. While establishments in the L.A. metropolitan area have not sprawled, warehouses have moved out an average of 6 miles. This suggests that within the L.A. metropolitan area, more truck miles are required to reach customers (for shipments or deliveries) in 2009 than was the case

in 1998. This is `relative sprawl,_ i.e. when logistics facilities move further away than the businesses they serve for pick-ups and deliveries.

SEATTLE RESULTS

In the Seattle area, the same sets of analyses were performed. The number of warehouses increased significantly within the study area, from 85 in 1998 to 212 in 2009, an increase of 149%. **Figures 5 and 6** show the number of warehouses by zip code for these two years, respectively.

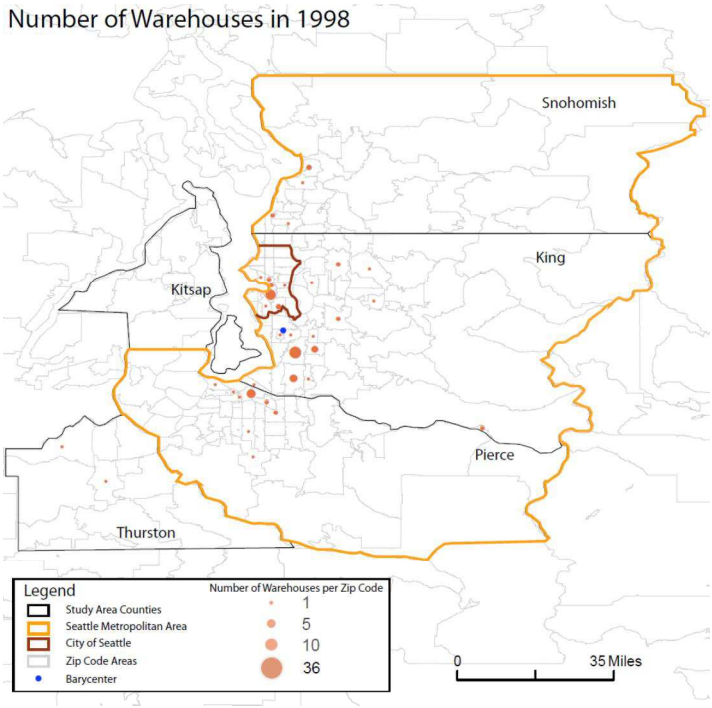

FIGURE 4 Seattle area warehousing, 1998 (Source: U.S. Census County Business Patterns).

In 1998, zip code 98032 had the most establishments at 15, and zip code 98134 was the only other zip code with more than 7. There were 35 total zip codes with a warehousing establishment, and 85 total establishments in the area. All but 5 zip codes had 3 or fewer warehouses. There was nothing to the west of the Puget Sound, and only two zip codes with establishments in the Olympia area. The barycenter was plotted as a star.

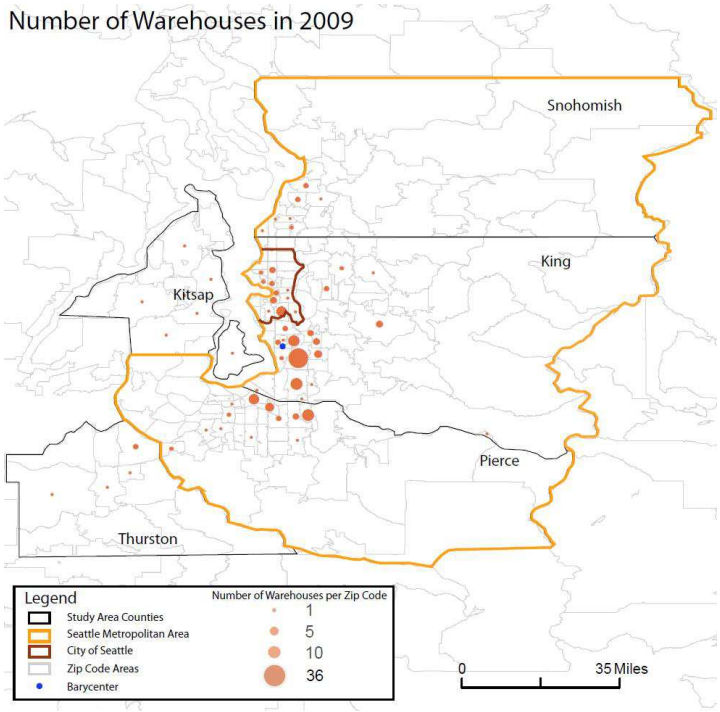

FIGURE 5 Seattle area warehousing, 2009 (Source: U.S. Census County Business Patterns).

By 2009, however, the total number of establishments had increased to 212. The number of zip codes with at least one establishment increased 74% from 35 to 61. To the southwest, there are now 5 zip codes with establishments compared to two in 1998. Where there had previously been nothing to the west of the Puget Sound, there are now 7 zip codes with at least one warehouse. There are also more zip codes with more establishments to the north.

The bulk of the new warehouses were built in the Kent/Renton area. Zip code 98032 had a 140% increase in number of warehouses, from 15 warehousing establishments in 1998 to 36 in 2009. There was a high concentration of warehouses near the barycenter in 1998, and additional warehouses were constructed in all of those zip codes by 2009. The barycenter shifted 2.27 miles to the southwest between 1998 and 2009.

The analysis was repeated for only King County, where the city of Seattle is located, shown in **Figures 7 and 8**, below. It was found that the barycenter moved 1.01 miles to the southwest, and the average distance from the barycenter decreased almost 20%, from 8.5 to 7.1 miles.

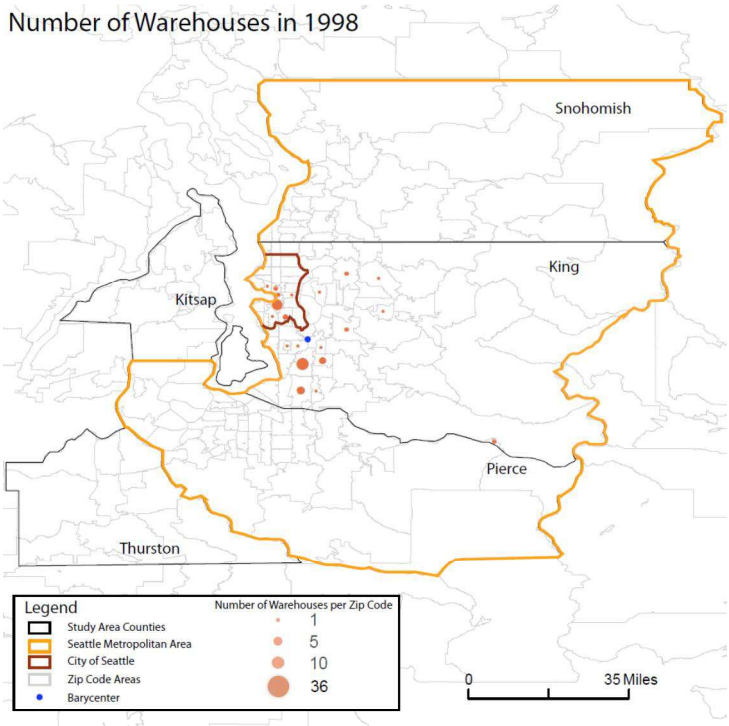

FIGURE 6 King County warehousing, 1998 (Source: U.S. Census County Business Patterns).

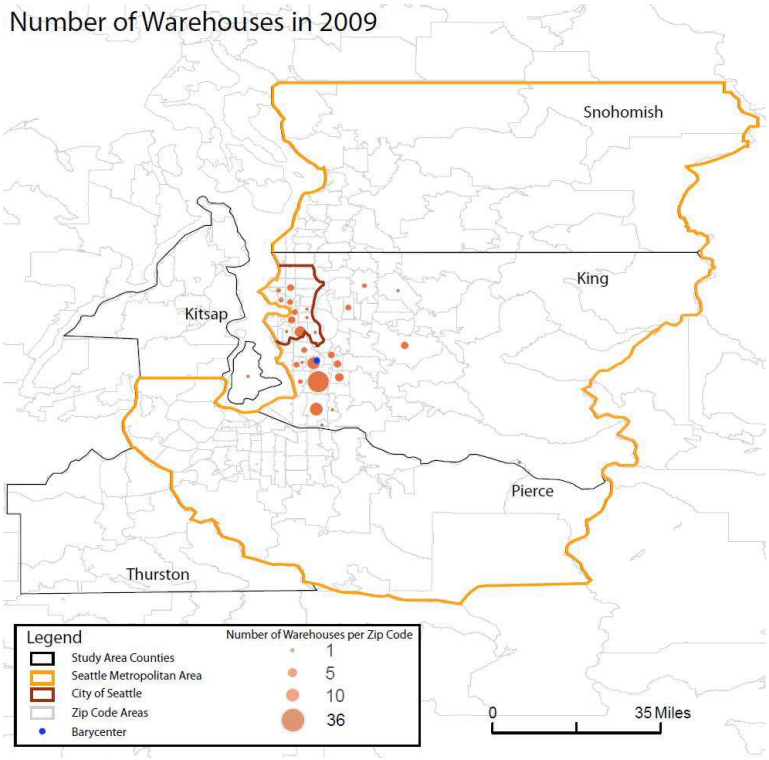

FIGURE 7 King County warehousing, 2009 (Source: U.S. Census County Business Patterns).

Similarly, the barycenter for all NAICS establishments in 1998 and 2009 was calculated. In this case, very little has changed other than growth in the total number of establishments. The barycenter moved 0.20 miles to the northeast.

As was completed with the Los Angeles data, the average distance of both warehouses and all establishments from their barycenter was calculated, with results as follows:

- In 1998, the average distance of warehouses from the barycenter was 12.8 miles, which decreased slightly to 12.0 miles by 2009, and
- The average distance of all establishments from the barycenter was 16.3 miles in 1998, compared to 16.5 in 2009.

These numbers suggest establishments in the Puget Sound region have not sprawled significantly since 1998. Warehouses specifically may have even contracted spatially a small amount, however given the uncertainty of exact locations of warehouses within a zip code, we would conclude that the average distance remained relatively stable.

DISCUSSION AND DIRECTIONS FOR FUTURE RESEARCH

Warehousing in the Los Angeles area has increased in two geographically distinct places ¯ in the metropolitan center, both in the city and in LA County near the city, and much further from the city in western Riverside and San Bernardino counties. The city of Los Angeles has long been a warehousing hub because of its proximity to the San Pedro Bay Ports and has a long tradition of manufacturing activities in various places including close to the Downtown area. However there is limited room for further expansion because it is so densely populated and the size of land parcels is limited. Further east in Riverside and San Bernardino counties, there is more available land for new warehouses, and this land is considerably less expensive. Suburban and exurban areas such as these can connect to a more complex system of regional and national flows than more urban areas. Zip code 91761, for example, had more establishments than any other zip code studied. While located further away from the San Pedro Bay ports, this zip code contains parts of Interstate 15, Interstate 10, and State Route 60. Ontario International Airport is also located within this zip code, giving the area further connections (air cargo activity was 437,000 tons in 2012). Additionally, many cities in these counties are taking steps to attract warehousing. The Coachella Valley Economic Partnership has stated that developing warehousing within the valley, which currently lies on the far eastern edge of the Inland Empire, is a high priority. Many have engaged in various promotional activities to attract logistics such as Moreno Valley (16, 24).

In the Seattle area, the number of warehouses and the number of zip codes with warehouses increased, including zip codes far to the southwest of the barycenter in Olympia, west across the Puget Sound, and north of Seattle. However few of these zip codes had more than one or two establishments. Only seven total zip codes had more than five establishments in 2009, and all were located less than 12 miles from the barycenter. Zip Code 98032 in Kent, WA, which has more than twice as many warehouses as any other zip code in the Seattle area, is approximately 10 miles by road to both the Port of Tacoma and Port of Seattle, and is less than two miles from Seattle-Tacoma International Airport. The significant clustering of warehouses in the Kent/Renton area, near the weighted geographic center, affected the distribution such that the overall distribution has contracted slightly.

In Seattle, it was found that several zip codes which previously did not have any warehouses gained some. The effect of this expansion was mathematically negated by the much larger increase in warehouses near Kent, WA, which is relatively close to Seattle. When repeating the barycenter analysis for only King County, shown in **Figures 7 and 8**, it was found that the barycenter moved away from the county to the southwest, but that warehouses in this area moved closer to the barycenter on average. The clustering of warehouses is centrally located between the Ports of Seattle and Tacoma. Additionally, it is very close to SeaTac International Airport, and it is located next to Interstate 5 and State Route 167, the two major north-south routes in the area.

Why do we observe a clustering, and increased concentration of warehousing activity in the Puget Sound region, but sprawl in the Los Angeles area? While not a conclusive analysis, we can point to several factors that may be significant, some of which provide opportunity for further research.

Local Factors

Some factors explaining the Seattle situation pertain specifically to Seattle. Zip code area 98032 is in a very favorable situation relative to the ports, airport, and freeways, and land was still available there at the end of the 1990s. Besides, there is a lack of large land parcels elsewhere, due in part to the physical geography of the Seattle metro area.

Very Large Metropolitan Areas vs. Smaller Metropolitan Areas

One hypothesis is that logistics sprawl is characteristic of very large metropolitan areas, which serve both as trade nodes to the entire region/country as well as enormous consumer markets. Distribution centers need to be located close to regional infrastructure networks in order to serve the local, regional and national economy. Differentials in land prices (suburban-ex-urban land prices compared with central land prices) may also be more important in the largest metropolitan areas. To our knowledge, no empirical studies nor theoretical works are available that could verify a relationship between city size and warehouses˘ locational behavior. Although not looking at this particular question, Hall and Hesse (2013) from several case studies identify an ideal-typology of the relationship between places and goods flows, drawing lines between cities that clearly have very different sizes (17).

Growth Management

Growth management looks at ways of conditioning residential and other developments to the provision of necessary services (utilities, infrastructure) and the minimization of negative impacts. It may have played a role in explaining the differences between Seattle and Los Angeles regarding the siting of logistics activities, although this second hypothesis requires further research. Unfortunately freight is generally omitted from the literature on growth management and sustainable transportation. Works assessing policy tools aimed at mitigating sprawl and climate impacts of transportation (25, 26) or proposing planning tools such as the `transport energy specification_ (27) are provided but do not mention freight. `Urban growth boundaries_ and `form-based codes_ are two planning strategies increasingly adopted in U.S. cities that are deemed interesting (28) because they are regional and long term. These are the policies implemented by the states of Oregon, Washington and Tennessee. Indeed, in 1990, the Washington State legislature adopted the Growth Management Act. The purpose of this act was to ensure coordination between local and state governments with regards to growth. Local governments are required to follow a comprehensive planning process for any potential new developments. The act created a framework that actually constrains how and where warehouses can be constructed and may have affected how the distribution of warehouses has changed over time. However, specific assessment of the Growth Management Act on warehouses has not been made.

California has not implemented a similar policy of coordinated planning. SB375, the State˘s CO_2 mitigation through growth management legislation, leaves much leeway to local communities for final decisions on land uses and has led to some interesting developments in freight planning. In 2011, for example, the San Diego Association of Governments (SANDAG) became the first urban region of California to adopt a Sustainable Communities Strategy as a mandatory component of its regional transportation plan. It includes two actions directly related to freight land uses: "Update the SANDAG Regional Comprehensive Plan (RCP) to include policies, programs, and guidelines to integrate goods movement land uses and facilities, with minimal impact to adjacent communities." And "Support and provide assistance for the update of local general plans to identify the long-term needs of moving goods, industrial warehousing infrastructure, and connectors to the regional freight network. Coordinate this effort with economic studies and RCP updates." SB375, however, is not comparable to the strategy adopted in Washington. In metro Los Angeles, there happened to be a lot of open space to the east, in the `Inland Empire_, the Riverside-San Bernardino-Ontario Metropolitan Area, which contributed to a

substantial increase in the number of warehouses there. This had the effect of both expanding the region as well as moving the barycenter to the east. While roughly 60 miles by road from the Ports of Los Angeles and Long Beach, these new warehousing districts are located in suburban areas near major freeways and an international airport. Due to the availability of cheap land, actions by suburban communities to encourage growth, and, potentially, lack of legislature to discourage growth, we see logistics sprawl occurring in the Los Angeles Metropolitan Area.

ACKNOWLEGEMENTS

The Los Angeles research was conducted by Laetitia Dablanc under the MEGAREGION project funded by IFSTTAR and the French agency for the environment including a visiting scholarship at the University of Southern California (2011-2012). Data collection and calculation of sprawl indicators were made by Victoria Farr, a Master˘s student from USC Sol Price School of Planning and Policy.
The idea for a joint paper resulted from Anne Goodchild˘s Fall 2012 stay at IFSTTAR through a University of Paris-Est grant program for visiting professors.

402 **REFERENCES**

403 1. Andreoli, D., Goodchild, A., and Vitasek, K. (2010). The rise of mega distribution centers and the
404 impact on logistical uncertainty.
405 2. U.S. Census Bureau. (2013). County Business Patterns: 1998.
406 ftp://ftp.census.gov//Econ2001_And_Earlier/CBP_CSV/zbp98detail.zip.
407 3. U.S. Census Bureau. (2013). County Business Patterns: 2011.
408 ftp://ftp.census.gov/econ2011/CBP_CSV/zbp11detail.zip.
409 4. Dablanc, L., and Ross, C. (2012). Atlanta: a mega logistics center in the Piedmont Atlantic
410 Megaregion (PAM). *Journal of transport geography*, *24*, 432-442.
411 5. U.S. Census Bureau. (2013). Metropolitan and Micropolitan Statistical Areas Main.
412 http://www.census.gov/population/metro/.
413 6. Bureau of Economic Analysis. (2011) Regional Data ¯ GDP & Personal Income. Retrieved
414 from http://www.bea.gov/iTable/index_regional.cfm.
415 7. Seattle.gov. (2010) The Greater Seattle Datasheet.
416 http://www.seattle.gov/oir/datasheet/economy.htm. Accessed July 18, 2013.
417 8. Sivitadinou, R. (1996) Warehouse and distribution facilities and community attributes: an
418 empirical study. *Environment and Planning A*, 28, pp. 1261-1278.
419 9. Dessouky, M., Giuliano, G. and Moore, J. (2008) Selected papers from the national urban freight
420 conference. *Transportation Research part E*, 44, pp. 181-184.
421 10. Christopherson, S. and Belzer, M. (2009) The next Move: Metropolitan Regions and the
422 Transformation of the Freight Transport and Distribution System, pp. 194-222 in Pindus, N.; H.
423 Wial and H. Wolman (Ed.) *Urban and Regional Policy and its Effects*, 2, Washington, DC:
424 Brookings.
425 11. Hesse, M. and Rodrigue, J.P. (2004) The transport geography of logistics and freight distribution.
426 *Journal of Transport Geography*, 12(3): 171-184.
427 12. Movahedi B., Lavassani, K. and Kumar, V. (2009) Transition to B2B e-Marketplace Enabled
428 Supply Chain: Readiness Assessment and Success Factors, *The International Journal of*
429 *Technology, Knowledge and Society*, 5 (3): 75-88.
430 13. Glaeser, E. and Kohlhase, J. (2004) Cities, regions and the decline of transport costs. *Papers in*
431 *Regional Science*, 83: 197-228.
432 14. Rodrigue, J.P. (2004) Freight, gateways and mega-urban regions: The logistical integration of the
433 BostWash corridor, *Tijdschrift voor economische en sociale geografie*, 95(2): 147-161.
434 15. Bowen, J. (2008) Moving places: the geography of warehousing in the US. *Journal of Transport*
435 *Geography*, 16(6): 379-387.
436 16. Dablanc, L. (2013) Logistics sprawl and urban freight planning issues in a major gateway city,
437 The case of Los Angeles. Forthcoming in Gonzalez-Feliu, J., Semet, F. and Routhier, J.L.
438 *Sustainable urban logistics: concepts, methods and information systems*, Springer.
439 17. Hall, P. and Hesse, M. (Ed.) (2013) *Cities, Regions and Flows*, Routledge.
440 18. Woudsma, C., Jensen, J., Kanaroglou, P., Maoh, H. (2008) Logistics land use and the city: A
441 spatial-temporal modeling approach, *Transportation Research Part E: Logistics and Transport*
442 *Review*, 44(2): 277-297.
443 19. Dablanc, L. and Rakotonarivo, D. (2010) The impacts of logistic sprawl: how does the location of
444 parcel transport terminals affect the energy efficiency of goods˘movements in Paris and what can
445 we do about it? *Procedia, Social and Behavioral Sciences* 2(3): 6087-6096.
446 20. Cidell, J. (2011) Distribution Centers among the Rooftops: The Global Logistics Network Meets
447 the Suburban Spatial Imaginary, *International Journal of Urban and Regional Research*, 35 (4):
448 832¯851.

21. Hesse, M. (2004) Land for logistics: locational dynamics, real estate markets and political regulation of regional distribution complexes, *Tijdschrift voor Economische en Sociale Geographie*, 95(2): 162-173.
22. De Lara, J. (2013) Goods movement and metropolitan inequality: global restructuring, commodity flows and metropolitan development. In Hall, P. and Hesse, M. (Ed.) *Cities, Regions and Flows*, Routledge.
23. Allen, J., & Browne, M. (2010). Considering the relationship between freight transport and urban form. *Green Logistics*.
24. Husing, J. (2010) *Dirt Theory: How Southern California˘s New Subregions Mature Economically and Its Implications for the Location of Distribution Facilities*. Appendix E in Comprehensive Regional Goods Movement Plan and Implementation Strategy Industrial Space in Southern California: Future Supply and Demand for Warehousing and Intermodal Facilities (Task 5 Report), June.
25. Grazi, F., and Van den Bergh, J. (2008) Spatial organization, transport, and climate change: Comparing instruments of spatial planning and policy. *Ecological Economics,* 67(4), pp. 630-639.
26. Bart, I.L. (2009) Urban sprawl and climate change: A statistical exploration of cause and effect, with policy options for the E.U. *Land use policy*, 27(2), pp. 283-292.
27. Saunders, M.J., T. Kuhnimhof, B. Chlond, and A.N. Rodrigues da Silva (2008) Incorporating transport energy into urban planning. *Transportation Research Part A*, 42, pp. 874-882.
28. Stone, B. (2010) Urban sprawl and air quality in large US cities. *Journal of Environmental Management*, 86, pp. 688-698.