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Spatial dynamics of the logistics industry: Evidence from California

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ABSTRACT

Is logistics decentralization a consistent trend across metropolitan areas? If so, is the trend more pronounced than population or employment decentralization? This paper examines logistics industry location trends from 2003 to 2013 in the four largest California metropolitan areas: Los Angeles, San Francisco, San Diego, and Sacramento. We define measures of both decentralization and de-concentration and compare logistics location trends with those of population and employment. Decentralization with respect to logistics establishments and employment is confirmed for Los Angeles; the other metro areas show mixed results. Possible explanatory factors include metropolitan size, economic development policies, share of non-local trade, and local geography.

1. Introduction

The purpose of this research is to examine changes in the spatial pattern of warehousing and distribution (W&D) activities and consider possible explanatory factors for observed spatial shifts. This is a first step in determining the extent to which spatial shifts may be a problem worthy of policy intervention. This paper examines recent trends in W&D location in four metropolitan areas in California.

One of the most notable trends in metropolitan areas is the rapid growth in warehousing and distribution activity. In the US, the number of warehousing establishments increased 15%, and warehousing employment increased 33% between 2003 and 2013. In contrast, total establishments and employment increased by 3% and 4% respectively. Explanations for this growth include continued globalization, changes in consumer demand, advances in information, communication, and transportation technology, just-in-time production, and restructuring of the logistics industry (Hesse and Rodrigue, 2004; Cidell, 2011).

W&Ds are part of goods supply chains. They are strategically located along the supply chain, considering land and transport costs, access to market, labor, and major freight nodes, such as airport and intermodal terminals (Bowen, 2008; Christopherson and Belzer, 2009; Cidell 2010 and 2011; Dablanc and Ross, 2012; Hesse, 2002, 2004, and 2007; Hesse and Rodrigue, 2004; McKinnon, 2009). Even if W&Ds are locating farther away from central urban areas, the question is whether they are decentralizing more than the markets they serve. We use measures of centrality and concentration and consider the distributions of population, employment and freight infrastructure. Our results are mixed. In general, we find decentralization with respect to employment, but not with respect to the number of establishments. Only Los Angeles shows decentralization across all measures.

The remainder of this paper is organized as follows. Section 2 provides a brief review of the literature. Our research approach is presented in Section 3, and data is described in Section 4. Section 5 presents results, and the report closes with some conclusions and suggestions for future research.

2. Literature review

As logistics systems for goods production and distribution have reorganized, so has their spatial structure. The reorganization of the logistics systems is well documented, but their spatial reorganization is not (Hesse and Rodrigue, 2004). Restructuring has been attributed to: 1) globalized market- and customer-driven goods production systems; 2) integrated management of information; 3) e-commerce, and consumer preference changes; 4) an increasing share of high value/low weight goods; and 5) increased competition due to 1970s and 1980s deregulation and liberalization in the US, and integration of European markets in the 1990s (Hesse and Rodrigue, 2004; Castells, 1996; Knowles and Hall, 1998; Dablanc et al., 2011).

2.1. Restructuring and decentralization

Restructuring has resulted in geographically fragmented supply chains, which imply geographically separated locations of suppliers, producers, distributors and consumers (Rodrigue, 2008). The concurrent spatial reorganization is attributable to pressure for economies of scale in goods production and distribution systems. Decreased freight transport costs and expanded freight transport capacity, due to technology

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advancement and infrastructure improvements, have eased spatial reorganization processes (Hall et al., 2006). These factors have facilitated the emergence of a logistics industry that puts emphasis on reliability and high throughput of goods transportation, which, rather than storage, has become the main goal of logistics (Hesse and Rodrigue, 2004). Moreover, demand for a integrated goods distribution system (e.g. logistics consolidation) increased significantly (Cidell, 2011; Rodrigue, 2008).

This systematic reorganization of logistics has generated a spatial reorganization of facility locations, termed the "new distribution economy" (Hesse and Rodrigue, 2004, p. 178). It requires efficient goods distribution chains that have become more and more sensitive to the spatial configuration of logistics facilities rather than direct transportation cost itself (Movahedi et al., 2008). Location decisions are based on securing proper access to international and intercontinental economies (Bowen, 2008).

Metropolitan population is the main driver for location of goods distribution activities in the conventional model (McKinnon, 1983). The new logistics system selects physical locations based on real estate costs (Hesse, 2006), access to highways and rail facilities (Rodrigue, 2008), access to low-skilled and low-wage labor, and reasonable business costs (Cidell, 2011). In particular, the rebalance on tradeoffs between transport and inventory costs play a significant role (McKinnon, 2009). Thus, optimal scale becomes a major factor in location choice (Dablanc and Ross, 2012). In addition, global supply chains prioritize access to major links in the national or international network (Hesse, 2002). Given the emphasis on scale and velocity, we would expect spatial shifts away from the urban core, due to development density, land constraints and arterial congestion (Hesse and Rodrigue, 2004). Agglomeration economies associated with the urban core are less valuable given the land requirements of large-scale facilities (Hesse and Rodrigue, 2004). In search of alternative locations, increased distance from the urban core offers cheaper land, larger parcels, access to congestion-free transportation infrastructure, and a supporting environment for logistics operations. The result is logistics decentralization and clustering of freight facilities in large metropolitan areas (Dablanc and Ross, 2012).

2.2. Empirical evidence

Empirical studies of W&D location are limited. Two aspects of spatial structure changes have been of particular interest: 1) movement of facilities from the urban core to peripheral places (decentralization) and 2) clustering of logistics functions (concentration).

An expansion of warehousing activities and associated W&D decentralization have been documented in three major US metropolitan areas, Atlanta, Los Angeles, and Chicago, during the 2000s (Dablanc and Ross, 2012; Dablanc et al., 2014; Goodchild and Dubie, 2016). These studies calculate the average distance of each W&D from the geographic centroid of all W&Ds (centrography). This measures the geographic spread but does not provide a comparison to population or employment shifts. Suburbanization of W&D activities was observed in metro areas in Sweden, the UK, and Japan as well (Heitz et al., 2016; Allen et al., 2012; Sakai et al., 2015). The decline of W&Ds in traditional port cities has been documented in six Canadian metro areas (Woudsma and Jakubicek, 2016). In contrast, W&D centralization is observed for Seattle, again using the same centrography measure (Dablanc et al., 2014). The authors surmise that W&D decentralization may occur only in very large metropolitan areas, in which the functions of major trade nodes and major consumer markets coexist. Cidell (2010) used Gini coefficients and observed de-concentration in US metropolitan areas (CBSA, Core-based Statistical Areas) 1986–2009. van den Heuvel et al. (2013), also using the Gini coefficient, but at the establishment level, observed increased spatial concentration in a province of the Netherlands 1996–2009. Thus, the empirical evidence on W&D decentralization and concentration is mixed.

3. Research approach

Anas et al. (1998) conceptualize urban spatial structure in two dimensions: centrality and concentration. Centrality is the degree to which activities are distributed in proximity to a single center. Urban structure may be centralized (activities closely located around the center) or decentralized (activities still spatially oriented to the center, but distributed across a larger distance from the center). Concentration is the degree to which activities are located within close proximity to one another and ranges from clustered to dispersed. Concentration can take many forms; there may be one or a few clusters, or many clusters. The share of activity that is clustered may also vary. The extreme case of no clustering is dispersion, a uniform distribution across space.

We use these concepts of spatial organization to characterize W&D locations and measure changes over time. We use both absolute and relative measures of centrality and concentration. Absolute measures provide information on changes in W&D spatial patterns with respect to a fixed point, such as the city center. Relative measures provide information on changes in W&D spatial patterns with respect to changes in other spatial patterns, such as the population distribution. Relative measures indicate where goods may be coming from or going to, and hence may provide some indication of how these changes could affect transport to and from markets. We generate four categories of measures: absolute and relative measures of centrality, and absolute and relative measures of concentration. Measures are listed in Table 1. There are many possible ways to generate these measures. For example, we could measure centrality by the average distance of all W&Ds to the city center, or to the geographic centroid of all W&Ds, as in the Dablanc and co-author studies (Dablanc and Ross, 2012; Dablanc et al., 2014). We, therefore, generate several different measures and compare results. Distance is calculated as Euclidean distance. We compared network and Euclidean distances; they are highly correlated and do not generate different results. We, therefore, used the simpler measure. Distance is calculated from the ZIP Code centroid and weighted by the number of W&Ds or employment.

We use measures based on both establishments and employment of W&Ds for two reasons. First, location choices of firms underlie changes in spatial distribution; hence, the establishment is an appropriate unit of analysis. Second, a measure of business size is also appropriate, because the research goal is to understand the effect of W&D location changes. In the case of W&Ds, the physical size of the facility (square footage) is

Table 1
Four categories of spatial structure measures

Spatial structure	Absolute	Relative
Measure of centrality	Measure 1. Decentralization	Measure 2. Relative decentralization
	1.1 Average distance to CBD 1.2 Average distance to freight nodes 1.3 Average distance to W&D geographic center	2.1 Average distance to all employment 2.2 Average distance to all population
Measure of concentration	Measure 3. Concentration	Measure 4. Relative concentration
	3.1 Gini coefficient for W&Ds	4.1 W&D concentration by total employment density quartiles