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Industrial space demand and freight transportation activity: exploring the connection

Christopher Lindsey [a], Hani S. Mahmassani [a,*], Matt Mullarkey [b], Terry Nash [b], Steven Rothberg [c]

[a] Transportation Center, Northwestern University, 600 Foster Street, Evanston, IL 60208, United States
[b] CenterPoint Properties, 1808 Swift Drive, Oak Brook, IL 60523, United States
[c] Mercator International, LLC, 620 Kirkland Way, Suite 206, Kirkland, WA 98033, United States

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ABSTRACT

There has been continuing interest among transportation planners, economic development specialists, and private industry about the relationship between the demand for industrial space and the level of freight transportation activity. With the growing importance of logistics and supply chain economics for many industrial and business activities, firms organizing their industrial activities and locating their warehousing and operational centers increasingly must consider the availability, quality, and cost of a range of transportation services, particularly in connection with essential intermodal activities. Accordingly, development of major logistics parks in conjunction with major intermodal hubs has become an important element in the overall industrial economy, predicated on the notion that robust freight activity is a good indicator of demand for industrial space. In this study, using regression techniques, we examine the relationship between freight transportation activity and industrial space demand at the metropolitan area level. The results confirm this relationship, reflecting significant statistical association between higher levels of freight traffic and higher levels of industrial space demand. This relationship is more pronounced in inland versus port markets. In addition, the data reveal that there was a shock to industrial space demand in 2001, thereby altering the structural relationship between demand and the drivers of demand.

1. Introduction

There has been continuing interest among transportation planners, urban geographers, economic development specialists, and private industry about the relationship between the demand for industrial space and the level of freight transportation activity. With the growing importance of logistics and supply chain economics for many industrial and business activities, firms organizing their industrial activities and locating their warehousing and operational centers increasingly must consider the availability, quality, and cost of a range of transportation services, particularly in connection with essential intermodal activities. Accordingly, development of major logistics parks in conjunction with major intermodal hubs has become an important element in the overall industrial economy, predicated on the notion that robust freight activity is a good indicator of demand for industrial space.

The geography of freight and logistics distribution, and its associated locational dimensions, has seen limited systematic investigation and scholarly research (Hesse and Rodrigue, 2004). However, the implications of these processes are considerable and of importance to a range of public and private entities. Regarding the public sector, the geography of freight flows affects overall land use and economic development within a region. The location of logistics facilities, in large part, determines region-wide truck traffic patterns, affects quality-of-life issues (e.g., noise, air quality, etc.) in local communities, and provides job opportunities for the area's residents, among others. Therefore, better understanding of the determinants of industrial space demand, its dynamics, and its interrelation with freight and logistics is of substantial importance to public entities.

Regarding private entities, consider the decision on where to locate logistics facilities (e.g., warehouses, distribution centers, etc.) within a supply chain. It has been estimated that approximately 50% of the total operating costs of a distribution center are related to transportation (Rodrigue, 2013). The importance of transportation costs in logistics decisions has led many firms to reconsider their market serving strategies and, consequently, the configuration of their supply chains. In recognizing the importance of transportation in logistics facilities location decisions, both

* Corresponding author. Tel.: +1 847 491 7287.
E-mail address: masmah@northwestern.edu (H.S. Mahmassani).

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the customer firms that demand those facilities and the provider firms that supply them must consider the geography of freight flows in supply chain decisions.

Motivated by the above considerations, this research explores the connection between industrial space demand and freight transportation at the metropolitan area level in the continental U.S. It provides some empirical insights, primarily with regard to transportation-related factors, within a rigorous analytical framework. The interrelation between freight flows and industrial land use is considered in conjunction with the macroeconomic and demographic factors that influence space demand. Accordingly, the objectives of the study are to: (a) identify the major economic drivers of industrial space demand in metropolitan markets, and (b) examine the relationship between industrial space demand and freight flow measures.

2. Background and literature review

It has long been observed that industries tend to cluster geographically (Marshall, 1920). This agglomeration of firms occurs because of the economic advantages gained from geographic proximity, namely: (1) knowledge sharing and spillover, (2) development of specialized and efficient supplier base, and (3) development of local labor pools with specialized skills. A particular type of cluster that is relevant to the work presented in this study is a logistics cluster. These consist of a collection of firms with logistics-intensive operations and typically include three types of companies: (1) logistics service providers – such as transportation carriers and third-party logistics providers (3PLs), (2) companies with logistics-intensive operations, and (3) the logistics operations of industrial firms (Sheffi, 2012, 2013).

Logistics clusters share many of the same characteristics that generally make industrial clusters attractive. However, logistics clusters have several unique characteristics that reinforce their formation and advantages, namely operational advantages related to transportation and asset-sharing (Sheffi, 2012). Effectively, logistics clusters allow carriers to lower their rates because of balanced flows into and out of the cluster, transportation conveyances that are full as opposed to only partially filled, and a dense transport customer population that increases the efficiency of the "last mile" – which is usually the most expensive one. In turn, firms are willing to pay higher rents to locate in logistics clusters because of these transportation cost benefits – among other advantages related to economies of scale, scope, and density – derived from clustering (Sheffi, 2012; Rodrigue, 2013).

In this regard, transportation access is an important element of firms' market-serving strategies because it is a primary determinant of the physical manifestation of a supply chain's distribution network (Chopra and Meindl, 2004). As firms decide the locations of logistics facilities, the supply chain's distribution network takes shape. This, in turn, influences the demand among markets exhibited by firms that consume industrial space.

2.1. The organization of industrial space

In general, access to transportation infrastructure plays an influential role in the location decisions of businesses across a wide range of industries (Targa et al., 2005, 2006). For those businesses in the industrial sectors, however, transportation access has been found to be particularly important, as evidenced by the organization of industrial space across metropolitan areas (Sivitanidou, 1996). As has been observed in a number of studies (Bowen, 2008; Hesse, 2008; Cidell, 2010; Allen et al., 2012; Dablanc and Ross, 2012), differences in transportation costs and land values, among other factors, have spurred a shift in logistics activities within and among metropolitan areas.

Particularly, logistics activities have shifted from urban cores to suburban areas across metropolitan areas in the U.S. and Europe, a phenomenon sometimes referred to as "logistics sprawl." Both Bowen (2008) and Cidell (2010) sampled 50 U.S. metropolitan areas and observed the distribution of logistics facilities and its relation to accessibility. Bowen (2008) concluded that air and highway network accessibility were particularly strongly correlated with the distribution of logistics facilities. Cidell (2010) reached a similar conclusion, but emphasized the observed shift in logistics activities from their traditional central locations to the suburban fringe. Using the Atlanta, GA, metropolitan area as a case study, Dablanc and Ross (2012) documented the region as a prime example of logistics sprawl.

Similar observations have been made in Europe. Allen et al. (2012) investigated the extent to which commercial and industrial land-use patterns influence the amount, pattern, and intensity of road-freight transport activity, and whether suburbanization of logistics activities is prevalent in the United Kingdom. They concluded that suburbanization has, in fact, occurred in the U.K. and, also, that proximity to the highway network and less expensive land are the likely reasons.

Though these studies do not examine the demand for industrial space as we do, but instead place a larger emphasis on logistics sprawl, they are still important to consider because their implications go beyond logistics sprawl and inform our knowledge of the overall organization of industrial space. The organization of industrial space influences market demand as firms organize their supply chains' distribution networks. The implication of these studies is that both *within* and *among* metropolitan areas, those communities with good accessibility to the freight network and lower land values stand to realize higher demand for space due to the reconfiguration of supply chains.

2.2. The demand for industrial space

Wheaton and Torto (1990) modeled the demand for, and completions of, industrial space as a firm "investment" decision. Using an "accelerator" type model, firms decide to produce industrial developments based on economic variables such as output (using employment as a proxy) and the after-tax cost of capital. This differs from our research in that we explore industrial real-estate demand from the consumer's perspective, as opposed to a developer's perspective as did Wheaton and Torto (1990). Whereas the latter examined the factors that drive supplier firms (i.e., real estate developers) to *invest* in certain locations, this study examines the factors that drive customer firms (i.e., firms that buy or rent logistics facilities) to *consume* industrial space in certain locations.

Hughes (1994) suggested that the factors affecting industrial property demand extend beyond commonly used measures such as population and employment growth to the true necessities of urban development. Hughes (1994) argues that the determinants of industrial demand in a particular location frequently are the same as those that cause an expansion of the economic base. Though some empirical data to support the argument that population growth alone may be a poor indicator of industrial demand, the work does not explore any empirical relationship between the suggested factors and actual demand.

Mueller and Laposa (1994), with later contributions by Mueller and Mueller (2007), developed the Path of Goods Movement (POGM) theory for studying warehouse space demand. The theory suggests that industrial employment has little bearing on the demand for warehouse space and is, in fact, more highly correlated with the location of distribution markets on the path that goods