Analysis of WDC trends in the United States

MetroFreight 4.1h
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INTRODUCTION

We evaluate at the national level the factors that might explain warehousing and distribution center (WDC) decentralization.

CONCEPTUAL FRAMEWORK

In metropolitan areas, local freight demand is a function of population size and industry mix. Hence, as metropolitan size increases, so does freight demand. Large metropolitan areas are also trade gateways, serving as nodes on the global supply chain. In high volume trade gateways, large-scale operation can reduce per-unit inventory cost. As a profit-driven entity, a warehouse operator seeks location attributes (e.g. land price) that enhance productivity. Recently, large WDCs have been built on the urban outskirts where cheap land is readily available. Consequently, the overall spatial distribution of WDCs has changed.

We hypothesize that the variation across metro areas (i) in freight volume (F_i) and land price distribution (L_i) explains the variation in WDC decentralization (ΔD_i), which is measured as the change in distribution when calculated as the average distance from the CBD to all warehouses. The general model is: $\Delta D_i = f(F_i, L_i)$. To identify WDCs, we use NAICS 493 Warehousing and Storage and ZIP Code level datasets (ZBP) for 2003 and 2013. FIGURE 1 shows scatter plots of WDC decentralization and metro size in population.

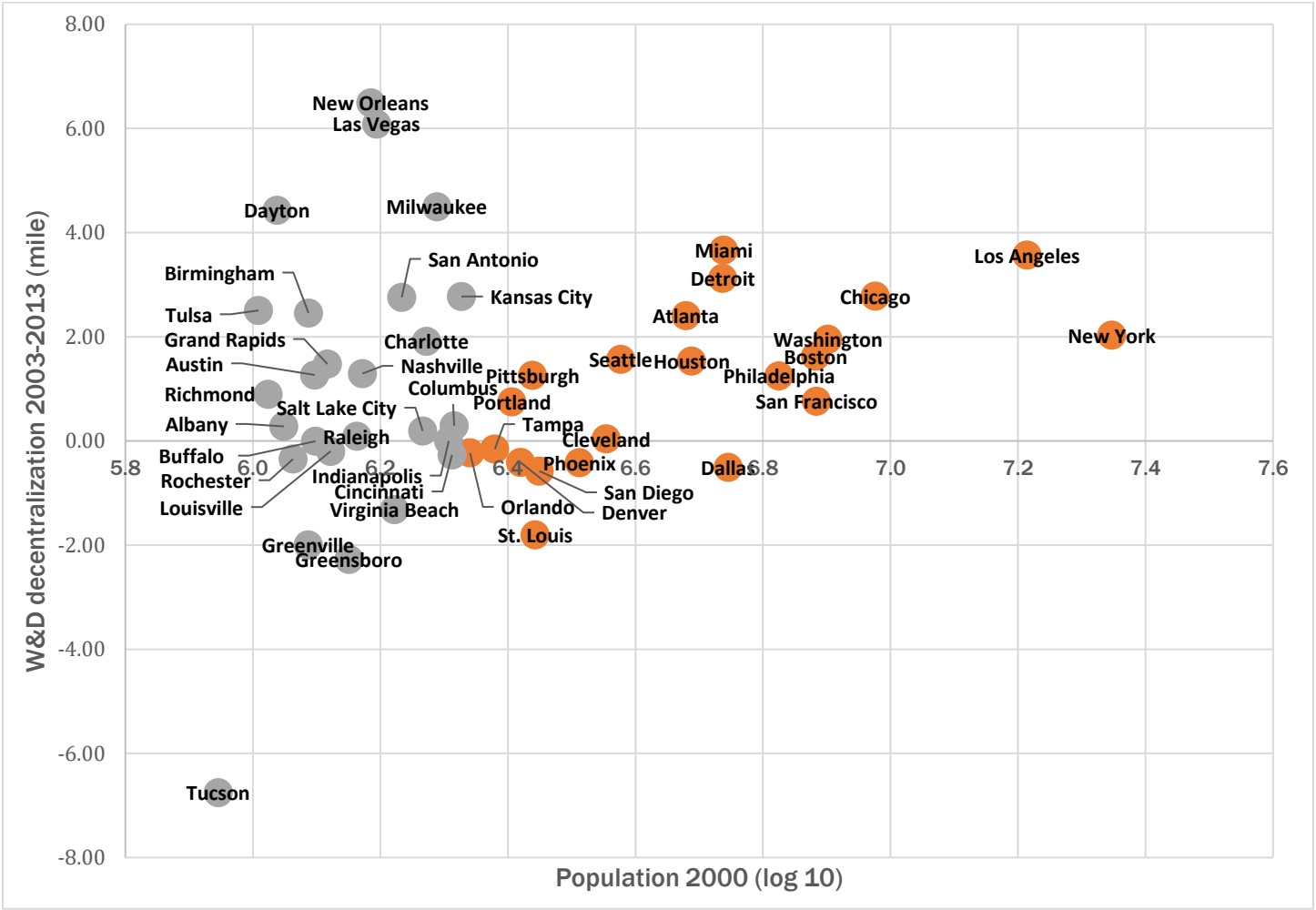

FIGURE 1 Scatter plot of WDC decentralization from 2003 to 2013 and 2000 population (Orange: large metro area; gray: small)

RESEARCH APPROACH

Unit of Analysis

48 metropolitan areas as shown in FIGURE 1

Spatial Distribution of Land Prices

The negative exponential curve of employment density approximates the spatial distribution of land prices: $D(x) = D_0 * e^{-G*x+u}$. where $D(x)$= employment density at distance x from the CBD; D_0= peak employment density at the CBD; G= density gradient; u= error term. To describe land price distribution, we use $log(D_0)$ (peak density at the CBD) and G (density gradient). We use ZBP 2003.

Freight Flow

We use the Commodity Flow Survey (CFS) 2002 and include all domestic freight volumes inbound and outbound (in log of million tons).

OLS Model

$$\Delta D_{i,t-1\ to\ t} = f\left(F_{i,t-1}, \Delta W_{i,t-1\ to\ t}, G_{i,t-1}, D_{0_{i,t-1}}\right)$$

Where, from 2003 (t-1) to 2013 (t); ΔW= change in the N of large WDCs (>100 employees); ΔD, F, G, D_0 all defined above. An interaction dummy for a small metro area is included: dummy = 1 if metro size rank > 22; dummy = 0 otherwise.

RESULTS

Results of Hypothesis Testing

Between 2003 and 2013, WDCs on average decentralized (+1.06 miles). Large warehouses (≥ 100 jobs) decentralized more than small ones (< 100 jobs). Large WDCs decentralized more in large metro areas than in small metro areas. We present the comparison of WDC distribution by facility size in TABLE 1.

Results of Regression Analysis

Controlling for all other factors, *density gradient (G)* across large metro areas had the largest impact on decentralization. *Peak density (D_0)* and *changes in large WDCs (W)* had almost half of this effect size. For decentralization of large WDCs, *density gradient (G)* and *peak density (D_0)* were equally influential. Decentralization in small metro areas was a function of *freight flow (F).*

CONCLUSIONS

We find that decentralization is correlated with freight and land demand. It is linked with very large metro areas and large WDCs. The demand for large scale facilities drives a search for lower land prices, which in turn pushes land intensive business to the urban outskirts. Effects are most pronounced for the largest metro areas. When freight and land demands are not high, there is less incentive for more distant locations and therefore less decentralization.

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TABLE 1 Comparison of the distribution of large and small WDCs

Test results	In 2003	In 2013
Large W&Ds (≥ 100 jobs) are significantly farther from the CBD	New York, Chicago, Washington-DC, San Francisco, Columbus, Nashville, Greenville	New York, Los Angeles, Chicago, Washington-DC, San Francisco, Boston, Philadelphia, Dallas, Houston, Atlanta, Charlotte, Nashville, Greenville
Not different	Los Angeles, Boston, Philadelphia, Dallas, Detroit, Houston, Atlanta, Seattle, Denver, Portland, Kansa City, Cincinnati, Indianapolis, Charlotte, Salt Lake City, Greensboro	Detroit, Seattle, Phoenix, Denver, Portland, Kansa City, Columbus, Cincinnati, Indianapolis, Salt Lake City, Greensboro
Large W&Ds are significantly closer to the CBD	Phoenix	-