Industrial Space Demand and Freight Transportation Activity
Exploring the Connection

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- An important supply chain decision is where to locate logistics facilities (e.g., warehouses, distribution centers, etc.).
  - [1]Approximately 50% of a distribution center's total operating costs are related to transportation.

- This has led to a strategic reconfiguration of supply chains to
  - decrease transportation costs, and
  - increase supply chain flexibility.

- Both sides of the market – the customer firms that demand logistics facilities and the provider firms that supply them through real estate ventures – must consider the geography of freight flows and regional dynamics in management decisions.

[1] Thompson & Meyer (2010) Five catalysts driving profound change in the global supply chain

- Problem Statement

- Research Questions & Objectives

- Background

- Methodology & Data

- Research Findings

- Research Implications

- Developers of major logistics facilities consider regional transportation hubs as prime investment markets, predicated on the notion that robust freight activity is a good indicator of demand for industrial space.

- This research explores that assertion by examining the relationship between industrial space demand, demographic, macroeconomic, and freight flow measures.

- **Research Questions**
  - Can industrial space demand be predicted as a function of demographic, macroeconomic, and freight flow measures?
  - Do regions with greater freight flows exhibit higher levels of industrial land consumption?

- **Research Objectives**
  - Identify the major economic drivers of industrial space demand in metropolitan markets, and
  - Examine the relationship between industrial space demand and freight flow measures.

- Location Theory
  - Transportation accessibility is a central tenet in seminal location theories (von Thunen, 1826; Christaller, 1933; Losch, 1944)
  - Transportation infrastructure important in empirical location studies (Targa et al., 2005, 2006; Hansen, 1987; Leitham et al., 2000)
- Industrial Space Demand
  - Path of Goods Movement – warehouse space demand is highly correlated with the path that goods flow from sources (manufacturers) to destinations (population centers) (Mueller and Laposa, 1994)
- Our contribution
  - Explore the demand for industrial space and its connection to macroeconomic, demographic, and freight flow variables

- Regression model for longitudinal data

$$y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$$

i	Metropolitan market
t	Year
y_{it}	Net absorption
α, β	Model parameters
X_{it}	Macroeconomic, demographic, and freight flow variables
ε_{it}	Model errors

– Atlanta, GA	– Detroit, MI	– Los Angeles, CA	– Phoenix, AZ
– Boston, MA	– Dallas, TX	– Minneapolis, MN	– Oakland, CA
– Chicago, IL	– Edison, NJ	– New York, NY	– Orange Co., CA
– Cincinnati, OH	– Houston, TX	– Riverside, CA	– St. Louis, MO
– Cleveland, OH	– Indianapolis, IN	– Philadelphia, PA	– Seattle, WA

Summary Statistics

| Variable	Description (Units)	Mean	Std. Deviation
Net Absorption	Net change in occupied space (Thousands of square feet)	5052	7209
Output	Percent Change in U.S. GDP not attributable to consumer expenditures for services (%)	2.965	2.012
Natl. Unemployment	Percent National Unemployment (%)	4.900	0.6119
Per-capita Income	Metropolitan area per capita income (Dollars per person)	43808	6540
Population Growth	2-year moving average of population growth at the metropolitan level (Unit-less)	0.01250	0.01068
State Employment	State level employment (Thousands of employees)	9122	5936
Origin Tons	Tons originating in a market (Millions)	121600	71575
Destination Tons	Tons destined for a market (Millions)	134100	73260
Origin Ton-Miles	Ton-miles originating in a market (Millions)	21890	14779
Dest. Ton-Miles	Ton-miles destined for a market (Millions)	130400	68915

Research Findings

Variable	Model 1 Coef.	z	Model 2 Coef.	z	Model 3 Coef.	z	Model 4 Coef.	z
Population Growth	1771	4.420	1771	4.240	1868	3.920	1755	4.290
Output	1611	8.750	1608	8.890	1632	8.510	1604	8.860
State Employment	246.2	2.510	261.3	2.640	234.6	2.040	251.8	2.630
Per-capita Income	-1372	-1.870	-1435	-1.920	-745.2	-1.010	-1602	-2.150
Natl. Unemployment	-2320	-4.220	-2318	-4.200	-2319	-4.090	-2325	-4.240
Origin Tons	2818	6.700	--	--	--	--	--	--
Destination Tons	--	--	2665	6.230	--	--	--	--
Origin Ton-Miles	--	--	--	--	997.6	2.430	--	--
Dest. Ton-Miles	--	--	--	--	--	--	302.8	6.780
Intercept	9769	3.020	9759	2.900	8183	2.460	10268	3.050
R-squared	0.4986		0.4936		0.4645		0.5008	

A large drop in demand is observed across all markets in the year 2001.
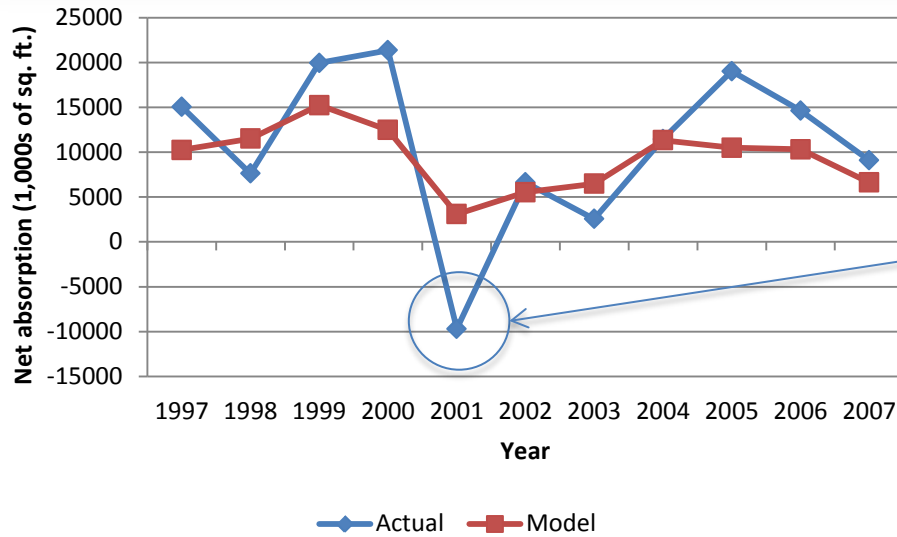
Atlanta, GA

Los Angeles, CA
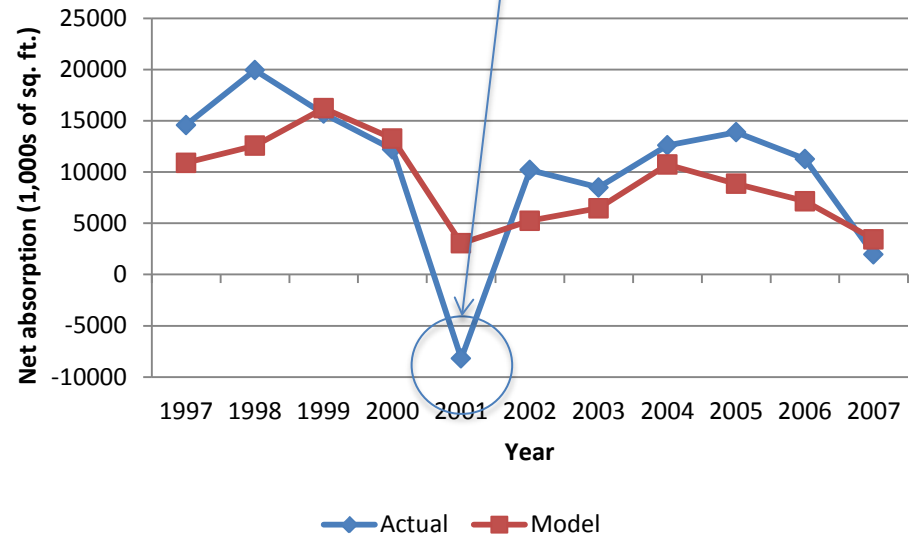
- Freight flows *are* an indicator of demand – strong positive association.

- Additionally, macroeconomic and demographic drivers of demand *can* be used to predict demand.

- Pre- and Post-2001 Demand
  - *Does the precipitous drop observed in the year 2001 represent a structural change in the industrial space market?*
    - Yes, it does. A Chow test is significant at 1%.

- Inland versus Port markets
  - *Is there a difference in the nature of demand between inland and port-proximate markets?*
    - Yes. In every case the effect of *land-side* freight flows is larger.

Pre- and Post-2001 Demand
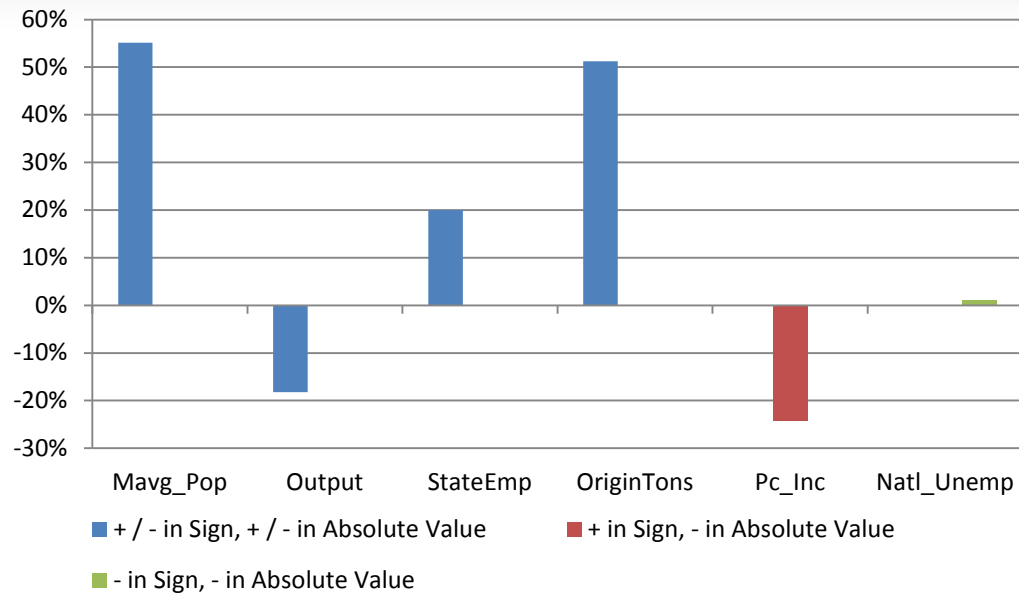
- Biggest difference was in population growth – nearly 55% higher in the post-2001 regime

- Smallest change was in the national unemployment, -1.13%

- Results imply that during the 2001 U.S. recession, demand depended heavily on local conditions

Port- vs. Inland-Market Demand

- Parameter estimates of land-side freight flows are larger.

Variable	Model 5 Coef.	z	Model 6 Coef.	z	Model 7 Coef.	z	Model 8 Coef.	z
...	...	...	...	...	...	...	...	...
Inland Origin Tons	3001	9.880	--	--	--	--	--	--
Port Origin Tons	2236	2.710			--	--	--	--
Inland Destination Tons	--	--	2819	8.440	--	--	--	--
Port Destination Tons	--		2119	2.850	--	--	--	--
Inland Origin Ton-Miles	--	--	--	--	1275	4.880	--	--
Port Origin Ton-Miles	--		--	--	644.2	1.530	--	--
Inland Destination Ton-Miles	--	--	--	--	--	--	317.4	8.530
Port Destination Ton-Miles	--		--	--	--	--	247.58	3.370
...	...	...	...	...	...	...	...	...
R-squared	0.5026		0.4968		0.4784		0.5035	

- Robust transportation infrastructures capable of handling large freight flows are a critical aspect of industrial space demand.

- Markets that are hubs of logistics activity, as indicated by freight flows, represent superior investment opportunities.

- A shock occurred in the year 2001 resulting in a structural change to the nature of demand.

- Freight flows are a better predictor of demand in inland versus port markets.

- Limitations
  - Though correlation between freight flows and space demand is clearly established, causality is not.
  - It is unclear whether the structural change resulting from the shock is temporary or permanent.
  - The predictive ability of the models is greatly hindered by the availability and timeliness of freight flow data.

- Future Research Directions
  - Firm-level choice process underlying location decisions
  - A more disaggregate measure of freight flows is desirable, however the CFS is the only publicly available source in the U.S.

Questions?

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