

SPATIOTEMPORAL ANALYSIS OF THE FREIGHT ANALYSIS FRAMEWORK DATA

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ABSTRACT

The objective of this study is to examine changes in freight flow intensity in the U.S. by demonstrating an applicable method utilizing publicly available Freight Analysis Framework (FAF; 2018) data. The FAF database is often used to study baseline and projected freight traffic volumes. However, since FAF data covers the entire US and spans the 1990s through 2010s, geographic trends in freight intensity over time can also be examined. Adapting the approach used by the US Census to study population shifts over time (for example, see Mackun and Wilson (2011)), this study examines geographic shifts in freight intensity over time. The general trend in US population shift since the 1800s has been westward (Kerski (2011)) and, in more recent years, towards the south. In this study, we examine freight trends from 1997-2012 and assess whether similar shifts in freight activity intensity have occurred. The analysis focuses on freight production and consumption by state using the available FAF data from 1997-2012. Comparisons to US population shifts in a similar timeframe are discussed.

METHODOLOGY AND DATA

Let $\bar{\phi}$, $\bar{\lambda}$ be the mean latitude and mean longitude of freight tonnage in terms of production and/or consumption.

The methodology used to calculate mean latitude and longitude mirrors the process documented in:

https://www2.census.gov/geo/pdfs/reference/cenpop2010/COP2010_documentation.pdf.

It involves computing the weighted average latitude and longitude of states, where the weights are the state-level tons. Three variations in tons are used in this study: production (origin) tons, consumption (destination) tons, and combined origin + destination tons. Tons across all commodities as well as for special flow types (imports; specific commodities) are examined as well.

A single center of mass is computed for the US as:

$$\bar{\phi} = \frac{\sum w_i \phi_i}{\sum w_i}$$

$$\bar{\lambda} = \frac{\sum w_i \lambda_i \cos(\phi_i (\frac{\pi}{180}))}{\sum w_i \cos(\phi_i)}$$

State centroids were found using GIS and are based on geographic boundaries. The population analysis uses a finer geography.

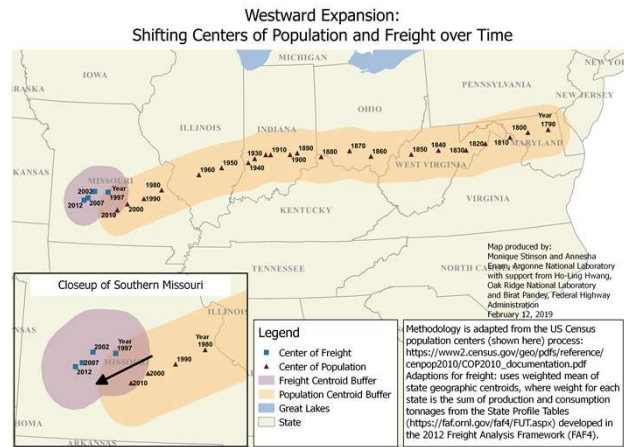
Mean latitude and longitude were computed for each of the four years that is available in the FAF4 state-level database: 1997, 2002, 2007 and 2012.

COMPARISON: POPULATION VS. FREIGHT

Interpretation:

- The population center has shifted gradually westward over time. It has also shifted slightly southward.
- The freight center follows a similar trend in terms of directionality.
- The trend are also similar in terms of magnitude (about 40 miles over a 15-year period).
- This suggests that freight production and consumption is correlated with population concentrations.

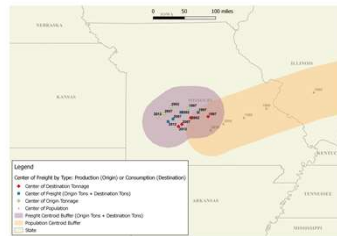
Note on Buffer: 50-mile radial buffers were generated around each centroid then smoothed. The buffers are used only as a visual device to better show directionality.



DISTINCTION BY ORIGIN AND DESTINATION

Centers of mass for All Origin Tonnes and All Destination Tonnes

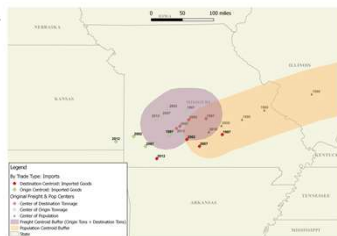
Interpretation: Origins (productions) tend to be slightly more north and west than destinations (consumption)



Centers of mass for Imported Goods

Interpretation: Origins are more north and west than destinations;

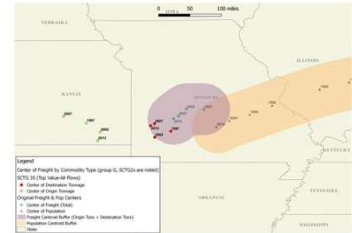
Both of these are south of the total flow centroids



DISTINCTION BY COMMODITY TYPE

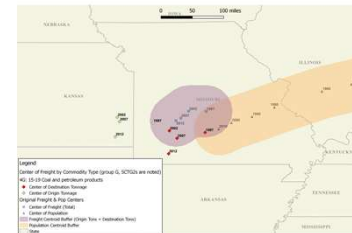
Centers of mass for SCTG 35 (Electronic and Other Electrical Equipment and Components, and Office Equipment)

Interpretation: Origin (productions) centroids are farther west than destination (consumption) centroids



Centers of mass for SCTG Group 4 (Coal and Petroleum Products, n.e.c.)

Interpretation: Origin (productions) centroids are farther west than destination (consumption) centroids



CONCLUSIONS

- Population and freight centers of mass are close and follow a similar trend in terms of direction (southwesterly) and magnitude of shift.
- This findings is consistent with our team's observations in other studies, where population concentration is strongly correlated with freight production and consumption concentration.

ACKNOWLEDGEMENT

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