

# Advanced metrics for freight rail and waterway economic development planning

Thomas N. Yoder, Ph.D., November 20, 2023  
Decision Commerce Group, LLC

---

Using advanced metrics in the situation analysis portion of the planning process helps to identify underlying performance issues that become the focus of the strategy portions of the process. In this article I present a few advanced metrics to support an economic development planning process that incorporates rail and water freight transportation-related investments. These metrics are calculated from publicly available data and are presented within the context of understanding regional economic competitiveness and investment viability.

---

## Issue

In past articles I have written about 1) the advantages of adopting portfolio management processes to sustain regional economies and 2) implementing performance indicators and management systems for continual tracking and process improvement. In this article, I focus on another component of adopting improved processes and methods: using advanced metrics in the situation analysis portion of the planning process. Adding advanced metrics to the process helps illuminate and define competitive and viability issues that underlie long-term performance. These issues define the scope of work for planning studies and resulting programs and actions that achieve regional goals.

Advanced metrics go beyond primary statistics that are often used by organizations as performance indicators. By digging deeper, we go beyond the overall results (effects) measured by the primary statistics to illuminate possible causes that determine these overall results. As an example, a situation analysis may include a trend line of a measure of results – such as declining Income and Gross Regional Product – to identify an issue of concern to a region. But adding advanced measures of the underlying productivity situation relative to other regions provides more insight on the issue of why Gross Regional Product may be declining. In this example, calculating advanced metrics that indicate trends in productivity helps to identify an issue and define a scope of work for further study.

In this article I present a few advanced metrics to support an economic development planning process that incorporates rail and water freight transportation-related investments. Since these two transportation modes offer economic productivity savings to industry by costing less per ton-mile of transport, a region may gain or maintain a long-term competitive advantage through its investments in railway and water transportation infrastructure.

## Discussion

Below I discuss selected freight industry use and transportation metrics to illustrate their usefulness in identifying issues to be addressed in planning. These metrics are calculated from published data and can be tracked over time based on data publication schedules. I provide examples using maps and charts of how to present these metrics across time and regions. This context is important for interpreting the value of a metric and providing an understanding of regional economic competitiveness and investment viability. The maps, charts, and data tables for these and other metrics are freely available in the Commerce Data section of our website at [decisioncommerce.com](https://decisioncommerce.com).

### Freight portfolio use metrics

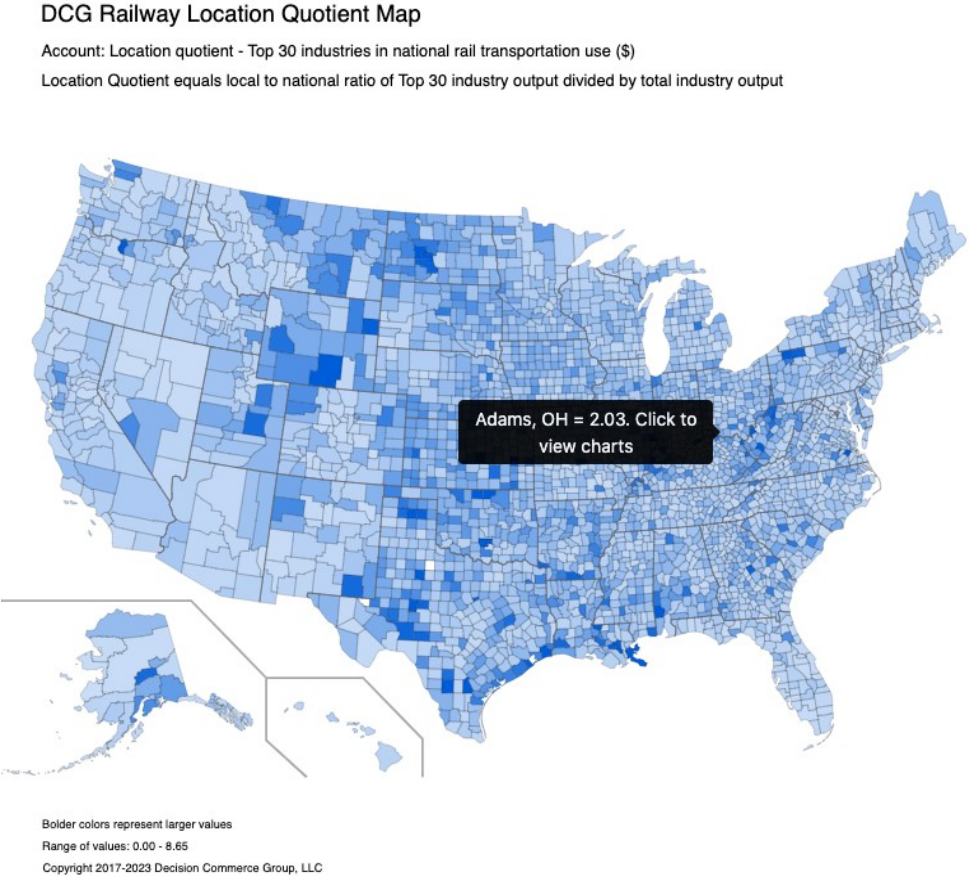
Economic development organizations facilitate the development of a sustainable, prosperous economy through their work in managing a portfolio of investments in infrastructure, industries, and programs. To support rail and waterway related economic development, organizations manage investments that affect location decisions for direct users of this transportation infrastructure. In addition, by fostering local development of supporting supplier industries, the investment multiplies, making infrastructure investments more financially viable for a region. Thirdly, by balancing a portfolio of industries across their growth, maturity, and decline stages, organizations sustain the return on their investments across their expected lifetimes.

The portfolio use metrics presented below inform the planning situation related to the management of these direct users, supporting industries, and portfolio mix and concentration. The first step in creating these metrics is to define portfolios of the top industries in national rail and waterway transportation use (\$) and use rate (\$ per \$output). We used these portfolios to create location quotient, industry contribution, and portfolio mix and concentration metrics.

*Location quotients for portfolio of top direct users* – We calculated location quotients for counties to indicate national location patterns for top users of rail and waterway freight transportation. This metric measures if portfolio production in a local area as a share of

total production is more, less, or about the same as the total national share. Compared to the standard metric of production level for an industry, the location quotient metric of a portfolio of transportation-using industries informs the planning process by providing context to interpret the production metric. With this information, planners can understand if their area has a relative under- or over-concentration of production in these industries.

The following map shows location quotients for the Top 30 Rail Transportation Use Portfolio. A value less than one indicates a lower share relative to the nation as a whole.



The following histogram shows the distribution of counties by portfolio location quotient. This chart puts the location quotient value for a specific county in the context of all of the other counties, indicating if a county is towards the bottom or top of the ranking for the portfolio metric.

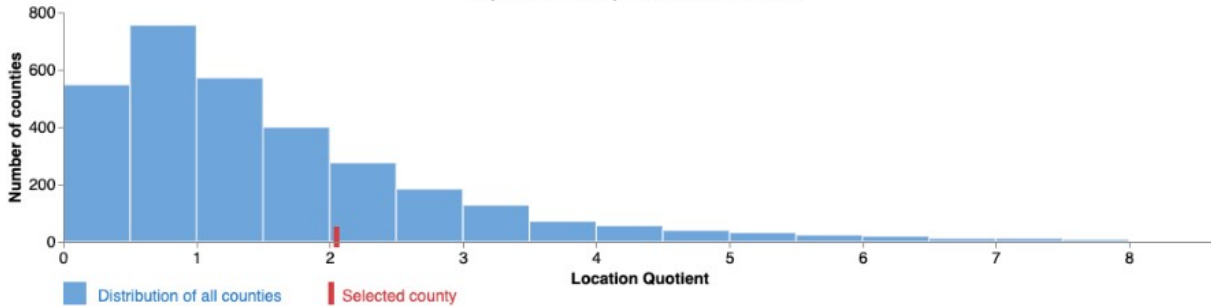
**Portfolio Location Quotients**

Region: Adams County, OH

Portfolio: Top industries in national rail transportation use (\$)

**County Distribution of Portfolio Location Quotients**

**Top 30 Rail Transportation Use Portfolio**



*Portfolio industry concentration* — In a local area, the portfolio may contain only a few of the top national users of freight water and rail transportation or most of the production may be concentrated in only a few industries. Less concentration is usually associated with a better mix of industries in mature and decline stages, lower economic risk, and increased investment viability.

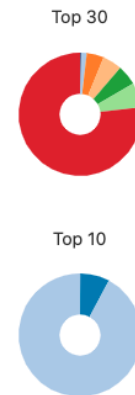
The following table and pie charts present industry mix and concentration in a local portfolio of Top 30 industries in national rail transportation use. Just a few big slices in the pie charts indicate a portfolio in which production is concentrated in a few industries. The projected growth rates indicate whether the industry sector is in a growth, mature, or decline stage.

**List of Industries**

Portfolio: Top 30

Industry	Local Output (2012\$)	Projected Growth Rate 2021-2031
Electric power generation, transmission, and distribution	151,806,200	0.036
Truck transportation	12,803,000	0.238
Poultry and egg production	10,517,687	0.282
Other plastics product manufacturing	9,947,000	0.089
Grain farming	9,039,846	0.14
Nonresidential maintenance and repair	2,698,215	0.154
Scenic and sightseeing transportation and support activities for transportation	701,400	0.2

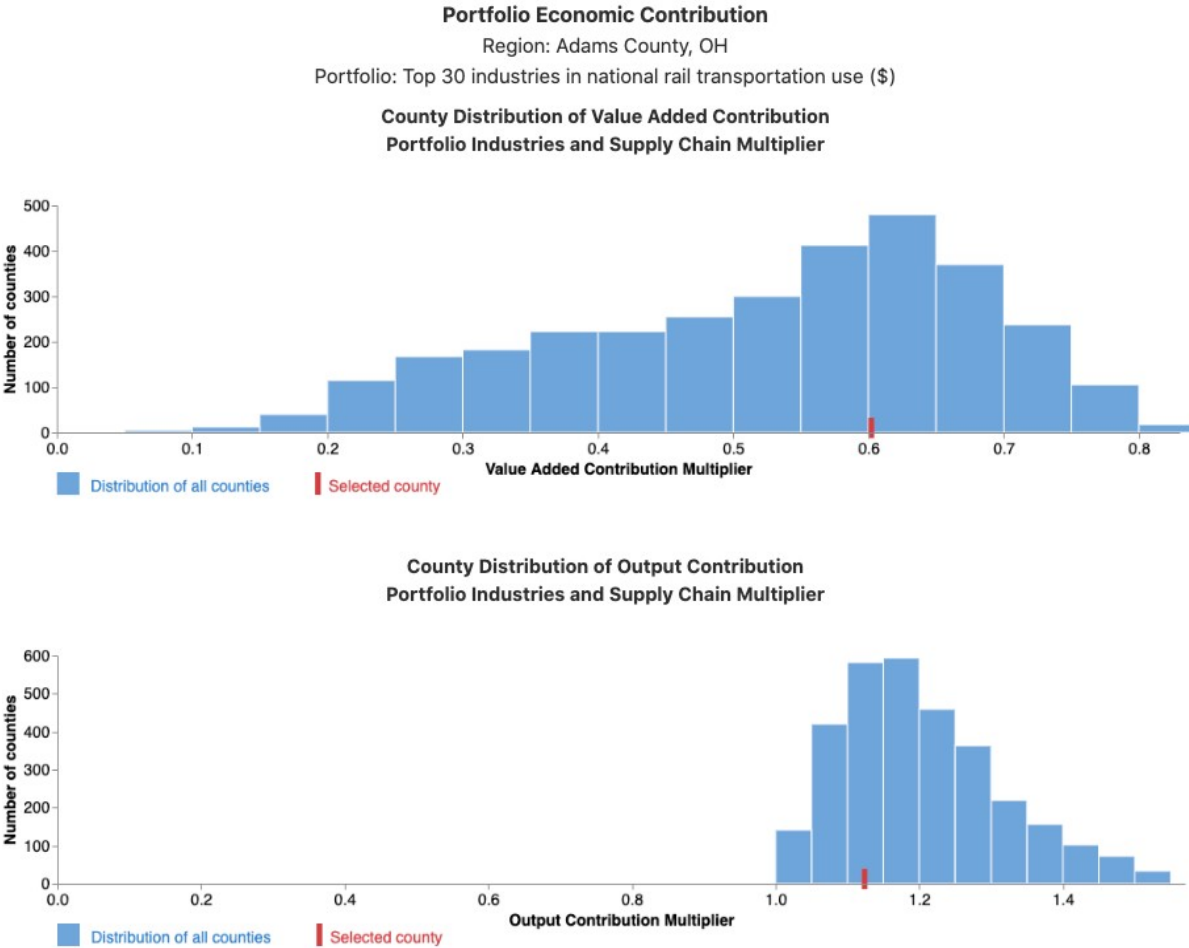
**Portfolio Concentration**



*Portfolio local economic multipliers for direct users and their suppliers* – Using the portfolio of industries, we computed local economic contribution multipliers for value

added, labor demand, and production output. These pro forma economic contribution multipliers indicate the capacity of local suppliers to meet the requirements for current direct industry users of rail and waterway transportation. Counties that have larger multipliers currently have larger local returns on their investment in this sector of the economy compared to other counties.

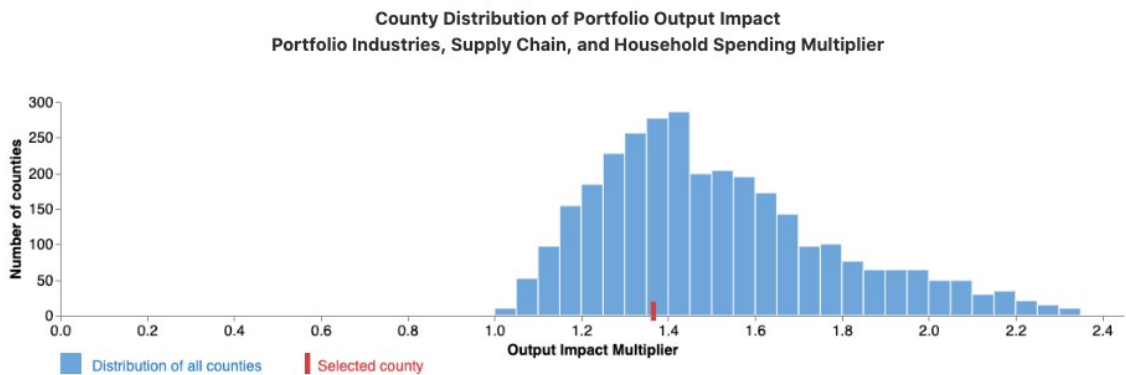
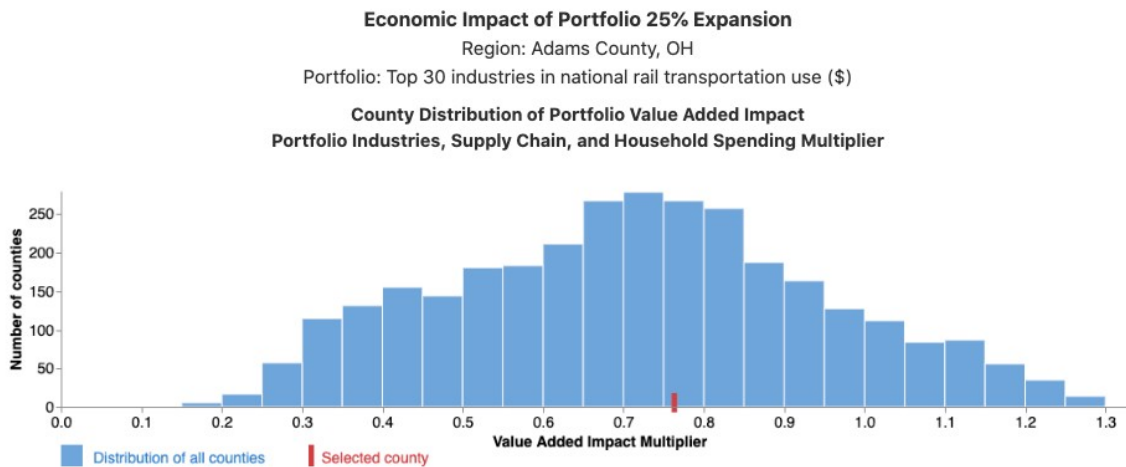
The following histograms show the distribution of counties by local contribution value added and output multiplier values. Counties with larger values generate more local income from investments and have more capacity to meet the supply requirements for portfolio industries.



We also computed local economic impact multipliers for direct users and the associated impacts back through the supply chain and forward through the spending of income. These multipliers measure on a pro forma basis the total economic return on the local growth of this portfolio of industries. Larger values indicate more local spending, spreading the initial growth in the portfolio industries more broadly across the local

economy. These multipliers are useful for planners when setting goals for economic development plans, such as increases in local income and jobs. The higher the multiplier, the easier it is to maintain a prosperous economy and the viability of investment projects.

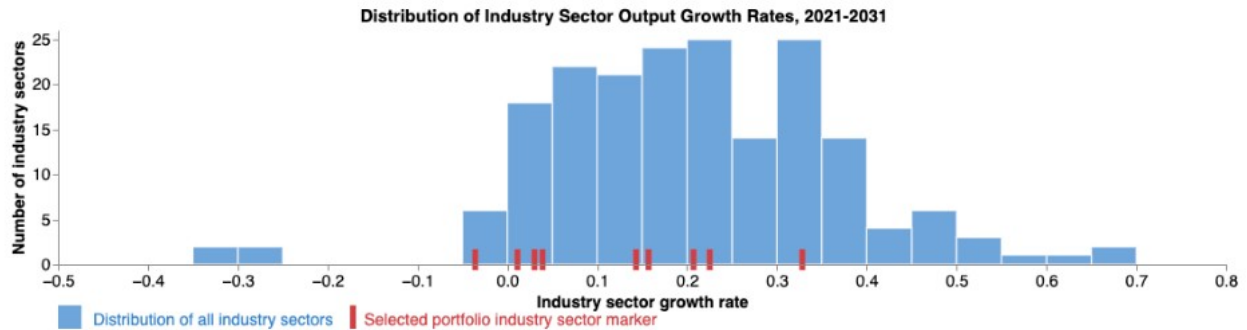
The following histograms show the distribution of counties by impact multiplier values. Counties with larger values keep money circulating in their local economy, resulting in a more prosperous local economy from any growth in portfolio industries.



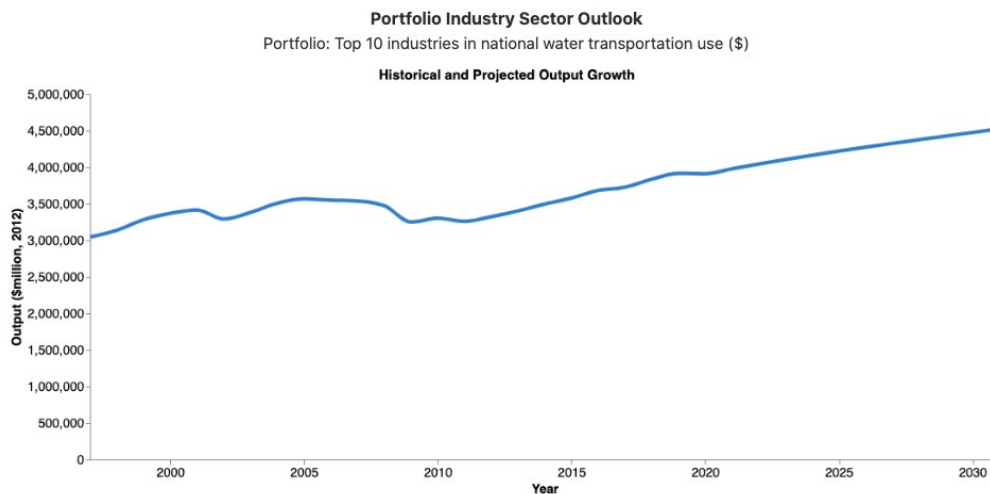
*Portfolio growth forecast* – The water and rail transportation national use and use rate portfolios we created include the top 10 or 30 industries. Using standard industry sector forecasts published by the Bureau of Labor Statistics, we can identify the mix of industries in the portfolio that are in their growth, mature, and decline stages as well as the projected growth for the portfolio as a whole. When most industries in a portfolio are in their decline stages, investment viability falls compared to the case where a large share of industries are in their mature or growth stages.

The following histogram shows the growth rates of industry sectors in the Top 10 Water

Transportation Use Portfolio overlaid on the distribution of all industry sector growth rates from 2021-2031. The portfolio includes a mix of industry sectors in maturity and decline stages.



The following chart shows the projected national growth rate for the portfolio as a whole.



### Freight transportation metrics

The portfolio growth projections, when overlaid on each region’s mix of industry production, inform traffic flow forecasts for inbound receiving, outbound shipping, and through traffic. These forecasts inform planners on the viability of infrastructure investments over the longer term given the current situation of industry location patterns. If the portfolio industries operating in a region are all in the decline phase, for instance, traffic flow forecasts will also show a decline in outbound shipping or inbound receiving, or both. Planners can affect these forecasts through infrastructure investments that make rail or water transportation accessible to more of a region’s industry users and lower an area’s transportation costs (their transportation basis) and

an industry's national average cost of production.

Developing a plan that affects these forecasts requires a detailed understanding of a region's industry and transportation competitiveness. Along with the portfolio use metrics discussed above, using some calculated traffic metrics in the situation analysis phase of planning helps in clarifying issues and creating a detailed scope of work for planning studies. Below I present traffic metrics for this preliminary purpose of issue identification.

*Transportation infrastructure presence metrics* – Accessing direct rail and water transportation services is a function of the extent of rail track miles and the number of waterway ports and docks. I present two indicators of a region's accessibility at a county level. The first is a geographic indicator of infrastructure coverage. The Infrastructure Coverage Location Quotient measures transportation infrastructure per unit of land area relative to the nation as a whole. The second is an economic indicator of infrastructure coverage. The Infrastructure Output Location Quotient measures transportation infrastructure per unit of economic output relative to the nation as a whole.

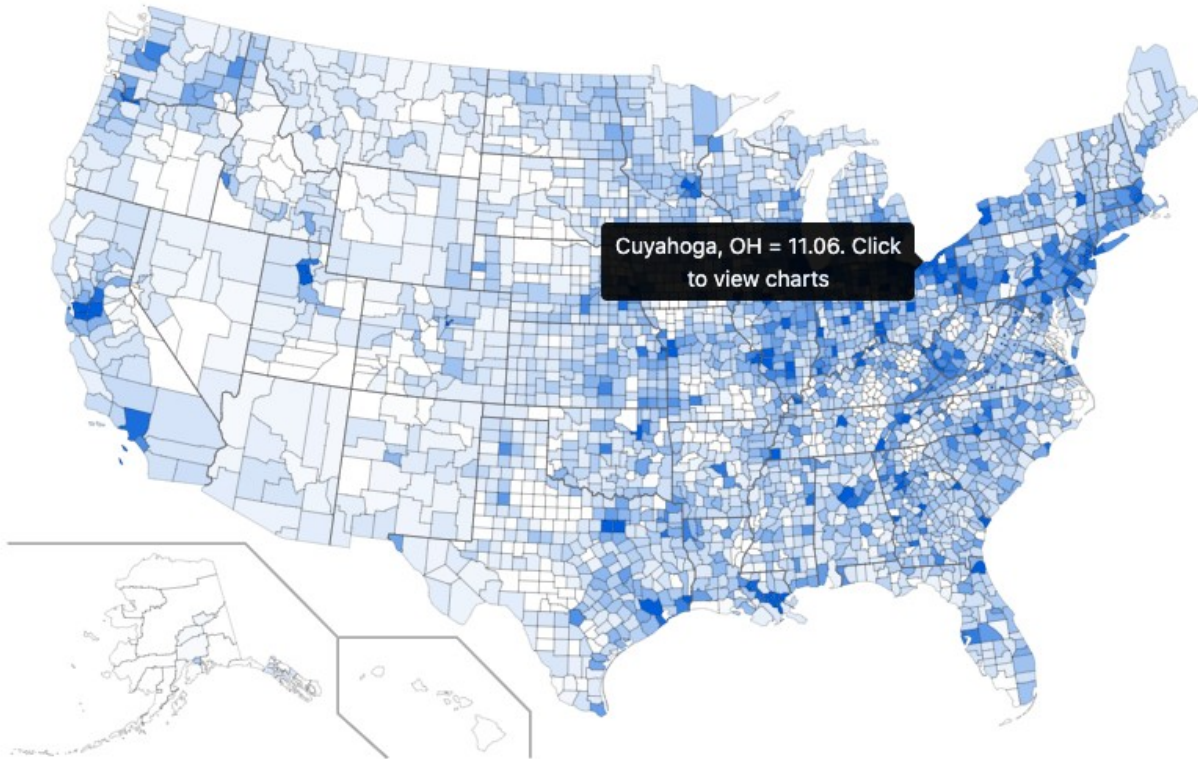
The following map shows the Rail Infrastructure Coverage location quotients by county. A value less than one indicates a lower share relative to the nation as a whole.



## DCG Railway Location Quotient Map

Account: Location quotient - Rail transportation infrastructure coverage

Location Quotient equals local to national ratio of number of rail miles divided by land area



Bolder colors represent larger values

Range of values: 0.00 - 67.73

Copyright 2017-2023 Decision Commerce Group, LLC

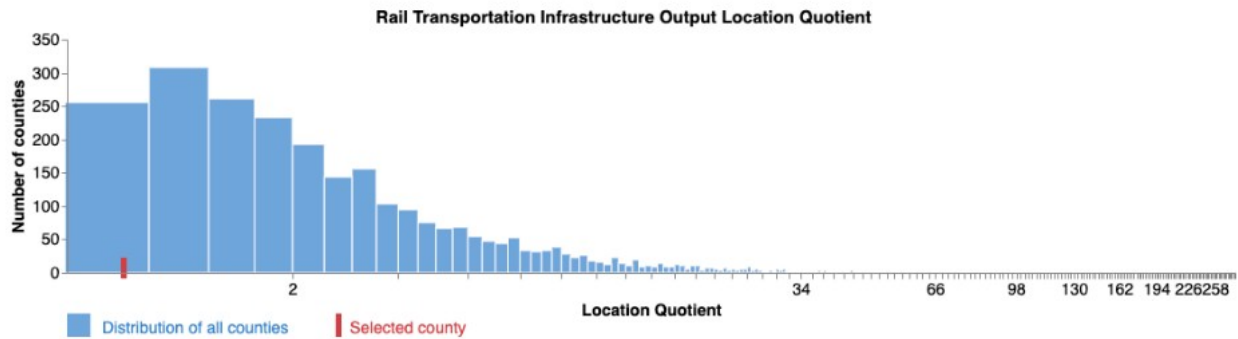
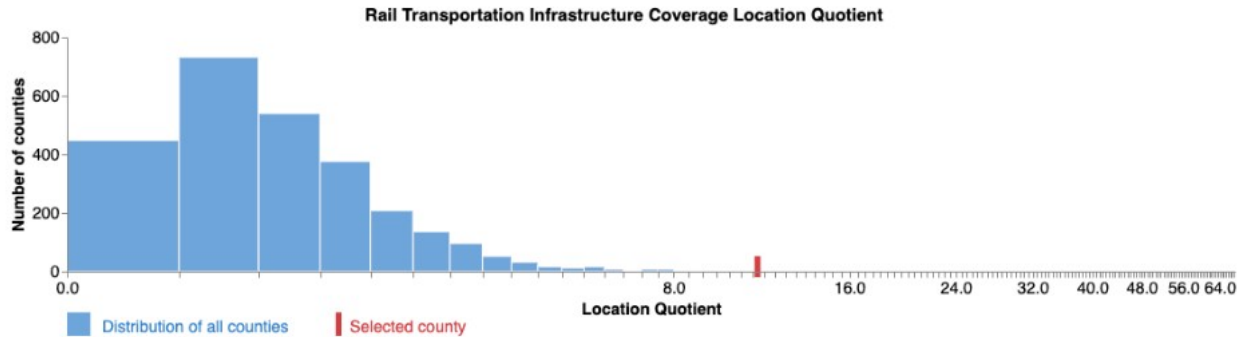
The following two histograms show the Rail Infrastructure Coverage and Output Location Quotients, with a marker for the selected county. These charts indicate if a county has more or less track coverage compared to the nation as a whole relative to its land area and size of the economy.

### Railway Infrastructure Location Quotients

Region: Cuyahoga County, OH

#### County Distribution of Location Quotients

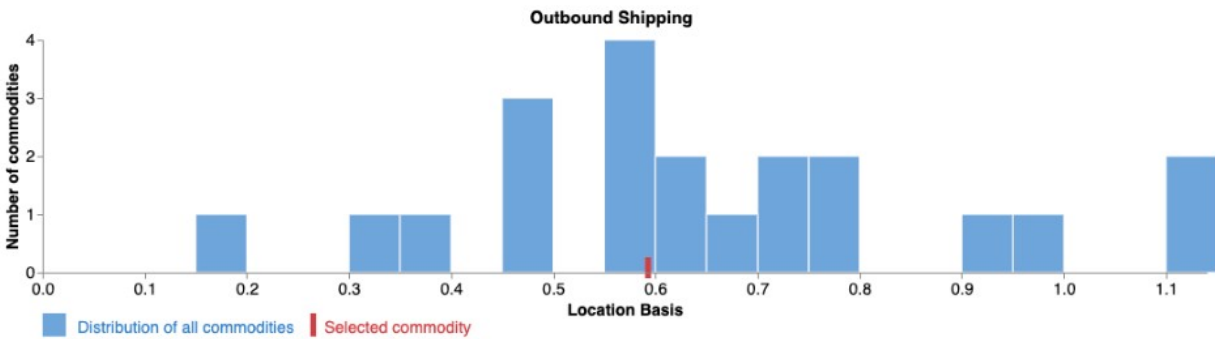
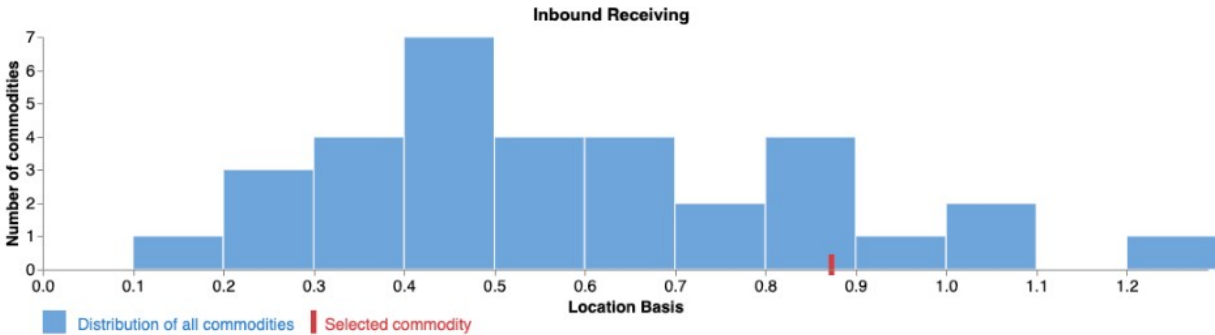
Rail Mileage



*Location basis for inbound and outbound traffic* – This metric is an indicator of a region’s proximity to suppliers and markets, with shorter distances resulting in lower transportation costs for the industry. The metric is calculated as the average distance for inbound receiving and outbound shipping trips for each commodity divided by its national average trip distance.

The following two histograms show the rail location basis across all commodities for a county, with a marker for the selected commodity.

**Location Basis Across Commodities**  
 Economic Area: Cleveland-Akron, OH-PA  
 Selected Commodity: Petroleum Refining Products  
 Year: 2021



## Guidance

In this article I presented a few advanced metrics to include in the situation analysis process for economic development planning. These metrics serve as an example of how to use publicly-available, government data sources that are periodically updated to improve the planning process. I recommend adding advanced metrics to better identify issues and specific research tasks to support planning decision-making.

Below I provide examples of potential planning objectives and research issues based on three sets of the advanced metrics discussed in this article. The third example includes joint planning and research for water and rail transportation economic development to capture synergies in economic competitiveness and investment viability. Joint planning is beneficial for local areas that have both water and rail transportation infrastructure since water transportation-using industries are also dependent on rail transportation to their customers who cannot be economically served by water transportation.

## Issue identification and planning guidance for example situations

Freight Use Situation	Freight Traffic Situation	Planning Objectives and Research to Support Economic Competitiveness and Investment Viability
<p>Direct industry share: Higher</p> <p>Local suppliers: Lower</p> <p>Portfolio mix: Mostly Declining</p> <p>Portfolio Concentration: Higher</p>	<p>Economic coverage: Lower</p> <p>Geographic coverage: Higher</p> <p>Location basis: Shorter</p>	<ul style="list-style-type: none"> <li>• Leverage local shorter location basis to invest in national portfolio industries; research to identify potential industries.</li> <li>• Create infrastructure plans for brown and green sites to improve economic infrastructure coverage.</li> <li>• Diversify and rebalance the local portfolio to improve investment viability; research to identify potential mature/growth industries from the national portfolio that fit with local economy and resources.</li> <li>• Invest in the supply chain to improve local return on and viability of infrastructure investments; research to identify potential industries that supply multiple local direct users to fully leverage supply chain investments.</li> <li>• Research to estimate the national industry productivity benefits and local economy effects of these investments to support public/private investment decisions.</li> </ul>
<p>Direct industry share: Lower</p> <p>Local suppliers: Higher</p> <p>Portfolio mix: Mature and Decline</p> <p>Portfolio Concentration: Higher</p>	<p>Economic coverage: Lower</p> <p>Geographic coverage: Higher</p> <p>Location basis: Shorter</p>	<ul style="list-style-type: none"> <li>• To improve investment viability over the long term, invest in adding national portfolio industries to leverage current infrastructure, shorter location basis, and local supply chain; research to identify potential mature and growth industries that benefit from current local economic competitiveness.</li> <li>• Create infrastructure plans for new sites to leverage geographic infrastructure coverage.</li> <li>• Research to estimate the national industry productivity benefits and local economy effects of these investments to support public/private investment decisions.</li> </ul>
<p>Direct industry share: Lower - Water Lower - Rail</p> <p>Local suppliers: Lower - Water Lower - Rail</p> <p>Portfolio mix: Declining - Water Mature - Rail</p> <p>Portfolio Concentration:</p>	<p>Economic coverage: Higher - Water Lower - Rail</p> <p>Geographic coverage: Higher - Water Lower - Rail</p> <p>Location basis: Shorter - Water Shorter - Rail</p>	<ul style="list-style-type: none"> <li>• To improve local investment viability, invest in adding mature water and rail national portfolio industries to leverage current water transportation economic competitiveness. research to identify potential mature and growth industries that benefit from water and rail shorter location basis.</li> <li>• Create infrastructure plans for rail to increase geographic and economic infrastructure coverage from lower to average national levels.</li> </ul>

Freight Use Situation	Freight Traffic Situation	Planning Objectives and Research to Support Economic Competitiveness and Investment Viability
Higher - Water Higher - Rail		<ul style="list-style-type: none"> <li>• Invest in the waterway and rail direct user supply chain to improve local return on and viability of infrastructure investments; research to identify potential industries that supply multiple local direct users to fully leverage supply chain investments.</li> <li>• Research to estimate the national industry productivity benefits and local economy effects of these investments to support public/private investment decisions.</li> </ul>