A Framework for Determining Highway Truck-Freight Benefits and Economic Impacts

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Background

• Quantitative analysis of freight investments prioritization is required.
• Few existing freight specific project impact analysis frameworks.
• Unable to capture full-range of freight related impacts stemming from freight investments.
  • Direct benefits: e.g. travel time savings
  • Indirect benefits: e.g. increasing in regional employment and income
Background

• Research objectives

• Propose a transparent framework for calculating both the direct freight benefits and the larger economic impacts of freight projects.

• Apply the framework for project evaluation and prioritization.
Methodology

- Identify benefits
  - Literature review
  - Three Technical groups (urban goods movement, global gateway, rural economies)

- Travel time savings
- Truck operating cost savings
- Emission changes
- Economic impacts
Methodology

**INPUTS**

- Project Specific Data Inputs
- Travel Demand Model (Spokane region TDM)

**MODEL FRAMEWORKS**

- Modeling Transportation Related Benefits
- Modeling Economic Impacts Using
  - Washington State CGE

**OUTPUTS**

- Benefits from:
  - Travel Time Savings
  - Operating Cost Savings
  - Emissions Changes
- Employment Changes
- Regional Economic Output

CGE: computable general equilibrium model
Methodology--Economic Impacts Analysis (EIA) -- Data

- Utilizes Social Accounting Matrices (SAM) from the 2010 IMPLAN data.
- Aggregate into 20 industrial Sectors:

<table>
<thead>
<tr>
<th>Aggregation Code</th>
<th>Freight Dependent Industries</th>
<th>Aggregation Code</th>
<th>Other Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGFOR</td>
<td>Agriculture and Forestry</td>
<td>INFO</td>
<td>Information Services</td>
</tr>
<tr>
<td>MIN</td>
<td>Mining</td>
<td>FININS</td>
<td>Financial and Insurance</td>
</tr>
<tr>
<td>UTIL</td>
<td>Utilities</td>
<td>REAL</td>
<td>Real Estate</td>
</tr>
<tr>
<td>CONST</td>
<td>Construction</td>
<td>PROTEC</td>
<td>Professional and Technical</td>
</tr>
<tr>
<td>MANUF</td>
<td>Manufacturing</td>
<td>MANAG</td>
<td>Management</td>
</tr>
<tr>
<td>WTRAD</td>
<td>Wholesale Trade</td>
<td>ADMIN</td>
<td>Administration</td>
</tr>
<tr>
<td>RTRAD</td>
<td>Retail Trade</td>
<td>SOCSER</td>
<td>Social Services</td>
</tr>
<tr>
<td>TRAWAR</td>
<td>Transportation and Warehousing</td>
<td>ARTS</td>
<td>Arts and Entertainment</td>
</tr>
<tr>
<td>TRUCK</td>
<td>Transport by Truck</td>
<td>FOOD</td>
<td>Food Services</td>
</tr>
<tr>
<td>WMAN</td>
<td>Waste Management</td>
<td>OTHR</td>
<td>Other (Including Government)</td>
</tr>
</tbody>
</table>
Methodology--Economic Impacts Analysis (EIA) -- Model

• Create four regional CGE models.
  • 2 Geographic scales
  • Long-Run (LR) and Short-Run (SR) scenarios
• Model the infrastructure investment as an improvement in technology.
  • Improves the productivity of the transportation system
• Initiate the CGE through a counterfactual that shifts the industry supply curve: (Cobb-Douglas shown for simplicity)
  \[ Q = S(K^\alpha L^{1-\alpha}) \]
  • Value of the shift is dependent upon the percent change in operating costs to the trucking industry
Case Study

- Interstate-highway widening project
  - 10 mile, 2 lanes each direction.
  - A critical connector for the region and serves approximately 9,000 trucks daily.
  - Freight demand is projected to increase by 30% over the next 10 years.
  - Adding one lane each direction.
  - 2035 build and no build scenarios were modeled by regional TDM.
**Case Study – Transportation Benefits**

- 2016-2035, Thousands of 2010 Dollars

<table>
<thead>
<tr>
<th>Benefit Category</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VHT reduction</td>
<td>295 hours</td>
</tr>
<tr>
<td>Truck travel time savings</td>
<td>$ 8,704</td>
</tr>
<tr>
<td>Truck operating cost savings</td>
<td>$14,613</td>
</tr>
<tr>
<td>Emission impacts</td>
<td>-$5,370</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$17,947</strong></td>
</tr>
<tr>
<td>Travel Demand Model Benefit Output</td>
<td>$ 4,533,563</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Spokane County Intermediate Expenditures (TRUCK)</td>
<td>$ 139,875,763</td>
</tr>
<tr>
<td>Statewide Intermediate Expenditures (TRUCK)</td>
<td>$ 1,760,368,000</td>
</tr>
<tr>
<td>Change in Truck Transport Productivity - Spokane County</td>
<td>3.24%</td>
</tr>
<tr>
<td>Change in Truck Transport Productivity - State</td>
<td>0.26%</td>
</tr>
</tbody>
</table>
## Case Study -- Economic Impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Initial Employment Level</th>
<th>Change in Employment</th>
<th>Change in Activity Quantity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SR</td>
<td>LR</td>
</tr>
<tr>
<td>County</td>
<td>264,128</td>
<td>25.5</td>
<td>77.9</td>
</tr>
<tr>
<td>State</td>
<td>5,647,012</td>
<td>22.4</td>
<td>47.2</td>
</tr>
</tbody>
</table>

**Price for truck services and regional output sales change:**

- **County**
  - SR: 1.94% decrease in price and $9.8 million increase in sales
  - LR: 1.67% decrease in price and $28.7 million increase in sales

- **State**
  - SR: 0.18% decrease in price and $10.5 million increase in sales
  - LR: 0.14% decrease in price and $22.2 million increase in sales
Limitations and Future Work

- Limitation of using TDMs
  - Not all model users are experts
  - Rely upon user defined parameters
  - Demand is fixed
  - Challenging to evaluate some benefits, e.g. travel time reliability
- Limited feedback loops between TDM and Impact Models
- Future work
  - Freight performance data
  - Enhancing dynamic nature of models
Conclusion

- A quantitative and transparent framework capturing full-range of freight related impacts can be used for freight project impacts assessment and project prioritization.
- Industrial base of a geographical region significantly impacts model outputs.