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

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Background

- Truck-freight related benefits should be recognized and acknowledged through quantitative project prioritization process.
- Most existing project assessment frameworks do not separately evaluate the truck-freight benefits of proposed highway infrastructure projects.
- Unable to capture full-range of truck-freight related impacts stemming from highway investments.
  - Direct benefits
  - Indirect benefits
Research Objectives

- Research objectives
- Propose a transparent methodology for calculating both the direct freight benefits and the larger economic impacts of freight projects.
- Apply the methodology for projects assessment.
Methodology

- Identify benefits
  - Literature review
  - WSDOT current project prioritization process
  - Three technical groups (urban goods movement, global gateway, and rural economies)
Methodology

- Direct freight benefits:
  - Truck travel time savings
  - Truck operating cost savings
  - Truck emission changes

- Economic impacts
  - Employment changes
  - Regional economic output changes
Methodology

Inputs

Project Specific Data Inputs

Travel Demand Model

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>OTHHR</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.
### Case Study – Transportation Benefits

- 2016-2035, Thousands of 2010 Dollars

<table>
<thead>
<tr>
<th>Benefit Category</th>
<th>Value</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>Total</td>
<td>$17,947</td>
</tr>
</tbody>
</table>
## Case Study -- Economic Impacts

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Demand Model Benefit Output</td>
<td>$4,533,563</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

- Limitations of using TDMs
- Limited feedback loops between TDM and Impact Models
- Future work
  - Freight performance data
  - Enhancing dynamic nature of models
Conclusion

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