An Enhanced Freight Activity Micro-simulation Estimator (FAME) Model using Freight Analysis Framework (FAF3.0) dataset

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INTRODUCTION

- Complex interactions among decision makers,
- Understanding of regional/national level of freight transportation,
- Policy assessments tools,
- Impact analysis of freight movement.
Actor-based microsimulation models

- Theoretically sounder
- Replicate individual decision-makers’ behavior
- Illustrate the interactions between markets
- The robust forecasting and assessment tools

- Less-researched field in modeling applications
- Data intensive
- Lack of “actor-based” frameworks
Simulation Practices

- **Urban models:**
  - Groningen, Netherland, *GoodTrip* (Boerkamps et al. 2000)
  - Tokyo, Japan (Wisetjindawat et al. 2007)
  - Calgary, Canada (Hunt and Stefan, 2007)
  - Toronto, Canada (Roorda et al. 2009)

- **Regional/National models:**
  - Sweden/Norway, *ADA* (de jong and Ben-Akiva 2008)
FRAMEWORK (operational)

- **Firm-type Generation:** Introducing individual decision-makers with their characteristics and geographical distribution
- **Supplier Selection:** Determining trade relationships between firm-types
- **Shipment Size Modeling:** Based on observed shipment size distribution
- **Mode Choice:** Using a probit model to select transportation mode (Truck vs. Rail)
- **Network Analysis:** Assigning commodity flows to the traffic network and assess the impacts
Firm Generation

- Categorizing decision making agents (firms) in the study area, based on their specifications:
  - Employee size,
  - Industry classification,
  - Location.

- Data:
  - County Business Pattern (CBP)
Firm Generation

Illustration by an example
Supply Chain Replication

- Consists of two tasks:
  - Developing a fuzzy rule-based Supplier Selection model
  - Disaggregating zonal commodity flows to firm level flows

Data:
- Results of UIC establishment survey
- Firms’ characteristics
- FAF industry to commodity crosswalk,
- 2007 Benchmark Input-Output Account,
Supply Chain Replication

➢ Illustration of outputs:
Shipment Forecasting

- Observed distribution of the shipments size by commodity type and by shipping distance was used from the CFS 2007,
- Iterative Proportional Fitting (IPF),
- Replicate the same distribution in FAME
- Shipments are categorized into 3 size groups
Mode choice

- UIC nationwide establishment survey
- A Probit model
- Truck vs. Rail
Network Analysis

- Under development
- Assignment of commodity flows to the network
- Impact analysis
Firm-types:

- A total of 45,206 firm-types were categorized,
- In all the domestic FAF zones,
- Determining factors:
  - Location (123 FAF zones),
  - Industry (328 NAICS),
  - Employee Size (8 clusters),
**SIMULATION**

Supply Chain Configuration:
- Simulated commodity flows in FAME;

<table>
<thead>
<tr>
<th></th>
<th>Weight (million tons)</th>
<th>Value (billion dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAF 2007</td>
<td>14,845</td>
<td>12,276</td>
</tr>
<tr>
<td>FAME</td>
<td>14,202</td>
<td>10,916</td>
</tr>
</tbody>
</table>

95% 89%
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SIMULATION

Chart showing the comparison of FAF (KTon) and FAME (KTon) for various categories of goods. The categories include:
- Cereal grains
- Other ag prod.
- Animal feed
- Meat/seafood
- Milled grain prod.
- Other foodstuffs
- Alcoholic beverages
- Tobacco prod.
- Building stone
- Natural sands
- Gravel
- Nonmetallic minerals
- Metallic ores
- Coal
- Crude petroleum
- Gasoline
- Fuel oils
- Coal-n.e.c.
- Basic chemicals
- Pharmaceuticals
- Fertilizers
- Chemical prod.
- Plastics/rubber
- Logs
- Wood prod.
- Newsprint/paper
- Paper articles
- Printed prod.
- Textiles/leather
- Nonmetal min.
- Base metals
- Articles-base metal
- Machinery
- Electronics
- Motorized vehicles
- Transport equip.
- Precision instruments
- Furniture
- Misc. mfg. prod.
- Waste/scrap
SIMULATION

relative percentage of truck shipments

CONCLUSION

Q/A
SIMULATION

relative percentage of rail shipments

- Tonnage
- Ton-mile
- Value

- CFS 2007
- FAF3
- FAME
CONCLUSION

Research Contribution:

- Use of publicly available data
- Using a separate component for supply chain configuration.
- Having an open structure
- Covers almost all the industry classes
- A wide geographic coverage
CONCLUSION

Future Works:

- Expand the second module (supplier selection),
- Develop a robust model for the shipment size,
- Consider international shipments as well,
- Consider use of intermediate handling facilities,
- Develop network analysis.
Thank you!