Measuring the economic contribution of road freight transportation

A case study in Miami, Florida with an input-output approach

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Outline of the presentation

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- Research objectives
- Methodologies
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- Results
- Conclusions
Literature overview

- Freight moves goods and maintains regional competitiveness

- Limited economic analysis studies on the role of road freight transportation in urban economy and its relationship with other economic sectors

- The lack of economic understanding might not support road freight policy making
Research objectives
Research objectives

- Examine the economic contribution of road freight transportation in urban economy

- Quantify the magnitudes of economic linkages of road freight transportation with urban economy

- Identify the industry sectors that have the highest economic linkages with road freight transportation from the perspectives of both demand and supply side of the economy
Methodology, study area and data
Model structure

Input-Output model

- An economic equilibrium model for modeling the demand and supply side of the economy
- Records input and output flows for economic sectors
- Quantifies the economic interactions among different economic sectors (e.g., industries, households, governments, etc.)
Model structure (Continued)

Conventional IO model

\[ X = (I - A)^{-1} \times F \]

Where \( X \) is the output matrix, \( A \) is the technical coefficient matrix, \( F \) is the final demand matrix

Credit: Blair and Miller 1999
Exogenous IO model

Conventional IO model considers final demand as exogenous,
\[ \Delta X = (I - A)^{-1} \Delta F \]

Industry output change, or policy changes could not be well represented in the conventional IO model (Cho 2017)

Exogenous IO model
\[ \Delta X = (I - A_e)^{-1} A_{truck} \Delta X_{truck} \]
In this study:

- **Exogenous IO demand model**
  - Exogenous industry output change in road freight transportation and its impacts on other sectors
    \[ \Delta X = (I - A_e)^{-1} \cdot A_{truck} \cdot \Delta X_{truck} \]

- **Exogenous IO supply model**
  - Criticized for many modeling limitations (Oosterhaven, 1988)
  - Accounts for the input price change under fixed quantities assumption
  - Exogenous industry input price change in road freight transportation and its impact on other sectors
    \[ \Delta X = R_{truck} \cdot \Delta X_{truck} \cdot (I - R_e)^{-1} \]

*\( A_e, R_e \) are matrix that excludes the exogenous road freight sector*
IO analysis of road freight transportation

- **Forward linkages**
  - Economic activities of other sectors requires input of the study sector (supporting)
  - Linkage > 1, higher forward linkages than the average sectors

- **Backward linkages**
  - Production activities of the study sector will induce greater industry activities from other industries (boosting)
  - Linkage > 1, higher backward linkages than the average sectors

- **Production inducing effect**
  - Additional industry output change and how it triggers economic activities in other economic sectors

- **Supply effect**
  - Supply shortage of study sectors and its impacts on other economic sectors
Data

- IMPLAN input-output data for the year of 2015
  - Single IO regional data
  - Greater Miami metropolitan area
- North American Industry Classification System (NAICS)
  - Two& Three digits NAICS sector scheme
  - Focus: General trucking sector (NAICS: 48484)
Results
Greater Miami metropolitan area

- Three counties: Miami-Dade county, Broward county, Palm beach county.
- Population in 2017: 6 million
- Employment in 2015: 3.7 million
- GDP in 2015: 300 Billion
- 11th largest city in the United States
- Regional and national freight gateway

Image credit: U.S Census Bureau
Florida freight flow by mode in 2012

Data source: Commodity flow survey 2012
Forward & backward linkages results

- 85 Detailed Forward and backward results not shown here
- Freight truck sector: Backward linkages 1.00
  - Above the average sectors (85 NAICS 3-digits sectors)
- Freight truck sector: Forward linkages 0.77
  - Below the average sectors (85 NAICS 3-digits sectors)
Production inducing effect results

Production inducing effect from $1$ million output of road freight sector

- Transportation and Warehousing
- Finance and insurance
- Real estate and rental
- Wholesale Trade
- Administrative and waste services
- Professional, scientific, and technical services
- Manufacturing
- Management of companies
- Information
- Retail trade
- Government and non-NAICS
- Other services
- Construction
- Utilities
- Accommodation and food services
- Arts, entertainment, and recreation
- Mining
- Ag, Forestry, Fish and Hunting
- Educational services
- Health and social services
Supply effect results

Supply effect from $1 million output of road freight sector

Manufacturing
Construction
Retail trade
Transportation and Warehousing
Real estate and rental
Wholesale Trade
Health and social services
Information
Professional scientific and tech services
Other services
Accommodation and food services
Finance and insurance
Administrative and waste services
Government and non-NAICS
Agriculture, forestry, fish and hunting
Arts, entertainment and recreation
Management of companies
Educational services
Utilities
Conclusions
Conclusions and planning implications

- An early stage of work to analyze the economic role of road freight in urban economy
- Based on B&F linkages analysis, road freight in Miami, Fl has relatively strong backward linkage than the average sector (>1), and lower forward linkage (<1).
- Expansion of the truck sector can help to induce additional economic activities in Miami’s economy, however, economic boom has relatively lower impact on road freight transportation.
- New production of road freight will majorly affect transportation, financing and insurance, whole sale trade, etc.
- Supply shortage of road freight will majorly affect manufacturing, construction, retail trade, etc.
Conclusions and planning implications (Continued)

- Enhance policy makers’ knowledge of which sectors have the highest impacts from road freight transportation investment.
- Economic impacts from supply of road freight (e.g. Panama canal expansion)
- Future work needed to integrate IO models with travel demand model to predict urban economic impacts from freight network changes.
Thank you!