Webinar Participants

Mechanics of the seminar

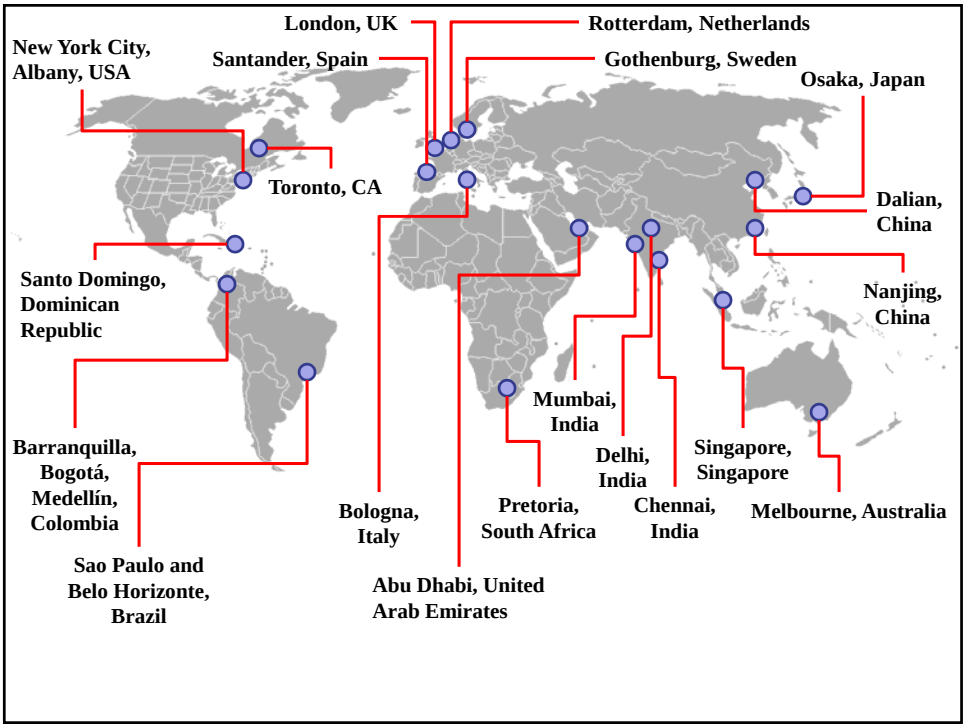
- The webinar is being recorded, the URL will be sent out to participants and posted at www.coe-sufs.org
- Participants from the US and Canada can:
  - Use Adobe Connect to receive the audio (PRIMARY method)
  - Dial 1-888-446-7584, access code 1120583
- International participants can:
  - Use Adobe Connect to receive the audio (PRIMARY method)
  - Use Skype or similar to dial 1-888-446-7584, code 1120583
  - Dial 212-372-3742 (caller paid call)
- Submit questions using the Chat feature

The VREF Center of Excellence for Sustainable Urban Freight Systems (CoE-SUFS)

CoE-SUFS

5

- Funded by the Volvo Research and Educational Foundations (VREF)
- Main Goal: To jumpstart an integrative process, involving cities, private sector, and researchers to develop new freight systems paradigms that:
  - Are sustainable
  - Increase quality of life
  - Foster economic competitiveness and efficiency
  - Enhance environmental justice



CoE-SUFS Dissemination Programs

- **Peer-to-Peer (P2P) Exchange** to share global best practices and real world examples of sustainable urban freight systems
- Next P2P (February 4th, 2015):
  - Engaging Stakeholders in Sustainable Urban Freight Initiatives: An International Perspective
    - Michael Browne, University of Westminster
    - Maria Lindholm, Chalmers University of Technology
- **Workshops** to bring together public/private sectors and academia, to jointly work to address urban freight issues
  - Already held at: India, Brazil, Colombia, Canada, Mexico, and Chile
  - Next ones:
    - Sidney, Australia (November 10-11, 2014)
    - Melbourne, Australia (November 12-13, 2014)

Modelling Commercial Establishments' Freight Traffic: A comparison of Alternative Methodological Options

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MIT Portugal

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Outline

1. Motivation for Freight Trip Generation models
2. Case Study: Lisbon, Portugal
3. Establishment-based Freight Survey
4. Freight Trip Generation Models (prediction of weekly deliveries)
5. Freight Trip Generation Models (prediction of weekly deliveries ranges and 2-Step)
6. Concluding remarks

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Motivation for Freight Trip Generation models

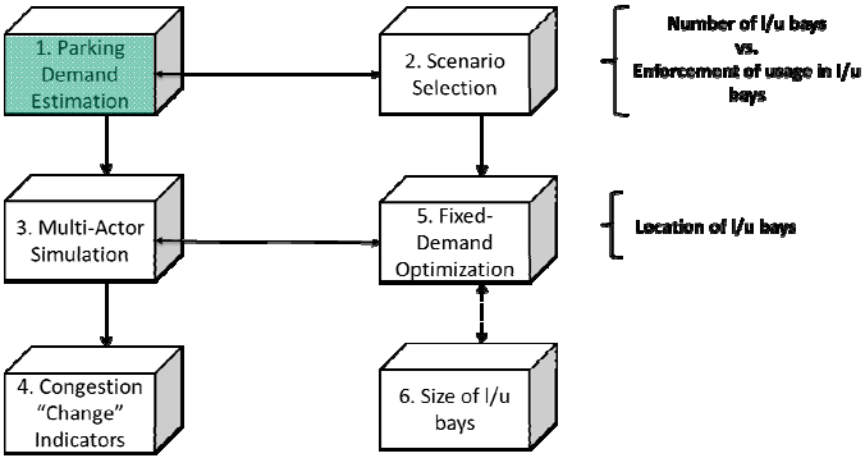
Motivation

Loading / Unloading bays

Enforcement **Congestion**

http://bragaciclavel.blogspot.com/2012/08/ainda-sobre-famosa-rua-d-pedro-v-porque.html

Motivation



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Case Study: Lisbon, Portugal

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Geographical Location

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Urban Form Characteristics

- 84.8 km^2 (urban: 958 km^2)
- 547,700 inhabitants (metro: 3,051,000)
- 17,346 retail establishments

Industry Category	Case study
Culture and leisure	9%
Food and drinks	33%
Health and hygiene	4%
Home appliances	7%
Non-specialized	2%
Non-specialized foodstuffs	5%
Personal usage articles	15%
Repairs	6%
Specialized foodstuffs	6%
Various	12%

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Establishment-based Freight Survey

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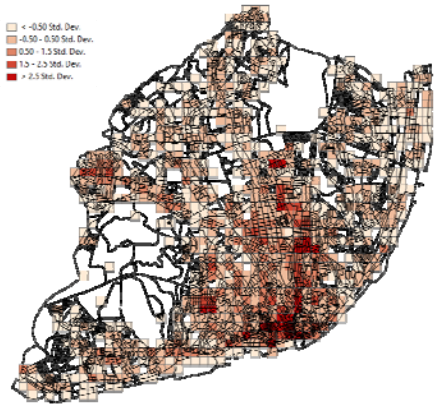
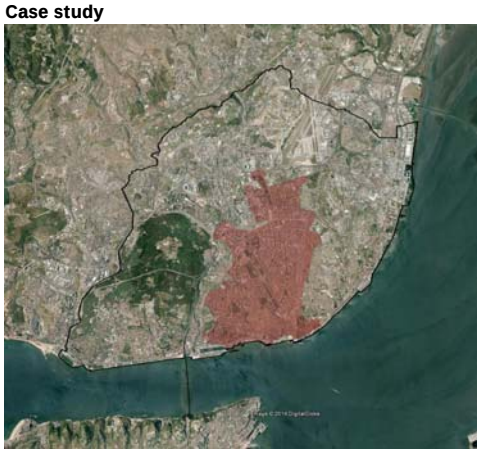
Case Study Selection

Establishments' density[1]



[1] calculated relatively to the average of *fishnet* zones with stores.

Case study



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Survey Methodology

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- First large scale Establishment-based freight survey.
- Random sampling stratified by zones and establishment categories.
- Sample 605 surveys vs. min. sample of 372 (margin of error: 5%; confidence level: 95%; response distribution for the highest sample size: 50%).
- No pre-contact. Single visit, multiple visits only for data correction purposes.
- Targeted solely on-street retail establishments with <500m^2.
- Focus on establishment characteristics, delivery details (e.g., parking location, vehicle type), and ordering process/supply chain.
- Questions framed to allow use of variables in the prediction of inbound Freight Trip Generation per store in a **weekly time period.**

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Survey Results

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- 82% of establishments independently owned and 79% are <100m^2.
- 68% of establishments do not own any vehicles and 27% have only one.
- 99% of those with a vehicle own a “light” vehicle and 14% have parking permit.
- Core goods represent 90% of deliveries and 66% of total deliveries are performed by a 3PL (third party logistics).
- 57% of establishments perform visual inspections to assess stock levels.
- 54% of establishments reported that vehicles double parked on the road for over 75% of deliveries

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Freight Trip Generation Models (Prediction of Weekly Deliveries)

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Data Preparation

- Dataset was subject to removal of unusual and influential (outlier) records.
- Process was based on two linear regression models with total deliveries per week as the DV and the IVs was the total employees/establishment area.
- Observations' influence was assessed by examining outliers and the leverage of the predictor variable values.
- 25 records were eliminated (~4%).
- Process allowed, in most cases, obtaining superior model quality (fit and statistical assumptions).
- The dataset was not split according to the industry category. All models are pooled and consider industry as a variable.

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Variable Influence Trends (Correlations)

	Emp X Del	Area X Del	Area X Emp
Overall	0.5	0.1	0.5
Health and hygiene	0.3	0.1	0.7
Foodstuffs	0.2	0.2	0.2
Personal usage articles	0.3	0.3	0.5
Food and drinks	0.5	0.2	0.5
Others	0.3	0.1	0.5

Value Coefficient	Strength
1.00	Perfect
0.7 - 0.9	Strong
0.4 - 0.6	Moderate
0.1 - 0.3	Weak
0.00	Zero

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Modeling Approaches

Technique	Advantages	Disadvantages	Test results
OLS Linear Regression	Widely documented application, including model quality tests	Relationship between variables not necessarily be linear	Non-normal error distribution; variable transformations partially solves issues
Generalized Linear Models (GLM)	Alternative models with non-normality and heteroskedasticity issues	Needs extensive testing to select right model specification	Mostly ok.
Multiple Classification Analysis (MCA)	Simple application: average trips for combination of variables	Predictions suffer from simplicity of the approach	Mostly ok.
Partition Method (PM)	Recursively partitions data according to variables relation and not always as interpreted	Model resolution depends highly on sample size, especially for higher levels	n/a

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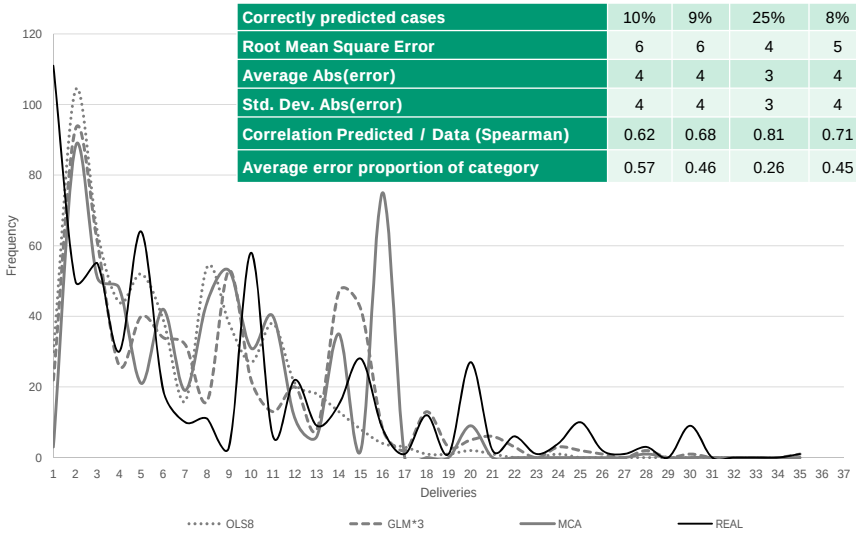
Selected Models Comparison

	OLS8	GLM	GLM*3	MCA	PM
Correctly predicted cases	10%	9%	25%	8%	9%
Root Mean Square Error	6	6	4	5	5
Average Abs(error)	4	4	3	4	4
Std. Dev. Abs(error)	4	4	3	4	4
Correlation Predicted / Data (Spearman)	0.62	0.68	0.81	0.71	0.72
Average error proportion of category	0.57	0.46	0.26	0.45	0.44



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Freight Trip Generation Models
(Prediction of Weekly Deliveries Ranges + 2 Step)

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Generalized Linear /Ordinal Logit / Multinomial Logit Regression

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- To achieve better predictions - simplify dependent variable - weekly deliveries were normalized to the following ranges:

Strata	Total weekly deliveries
1	1 delivery per week
2	2 to 4 deliveries per week
3	5 to 10 deliveries per week
4	11 to 20 deliveries per week
5	Over 20 deliveries per week

- Models also benefited from the inclusion of variable interactions, resulting in good predictions, but not necessarily in error quality.

1. Range prediction models	GLM	ORD	MLR
Correctly Predicted	55%	59%	62%
Correctly Predicted (Rnd 80%/20%)	35%	36%	35%
Correctly Predicted Random/Full Ratio	0.64	0.61	0.56
Correlation Predicted / Data	0.77	0.78	0.73
Error = 1 range (%)	90%	84%	71%

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Combinatory Models (2-step models)

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- Prediction of ranges and, for assigned range, predict the disaggregated number of deliveries.

Inside Range Models	GLM	ORD	MLR
Correct predictions	58%	62%	70%
RMSE	1	2	2
Average abs(error)	1	1	1
Std. Dev. abs(error)	1	2	2
Overall quality test results	F	F	F
Correlation Predicted / Data	0.99	0.99	0.99

1 + 2 = 2-step Models	ORD		
	MLR	GLM	ORD
Correct predictions	45%	40%	41%
RMSE	5	5	5
Average abs(error)	3	3	3
Std. Dev. abs(error)	4	4	4
Correlation Predicted/Data	0.79	0.79	0.79
Average error proportion cat.	0.30	0.27	0.34

Concluding Remarks

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Multiple Classification Analysis

	Employees				
Industry Category	**1**	**2**	**3**	**4**	**>4**
Category 1 – Specialized foodstuffs	9.8	11.8	10.7	14.5	10.0
Category 2 – Non-specialized foodstuffs	4.8	8.7	10.3	15.8	28.0
Category 3 – Personal usage articles	2.0	2.3	1.5	4.2	8.0
Category 4 – Culture and leisure	4.4	3.1	3.0	8.0	5.8
Category 5 – Various	6.5	8.2	10.1	5.8	3.3
Category 6 – Home appliances	2.5	4.3	4.3	11.0	6.0
Category 7 – Non-specialized	4.3	5.3	n/a	1.0	n/a
Category 8 – Health and hygiene	12.0	8.0	9.0	13.6	19.8
Category 9 – Repairs	1.0	4.7	3.3	7.3	12.8
Category 10 – Food and drinks	6.1	8.6	11.2	13.7	15.9

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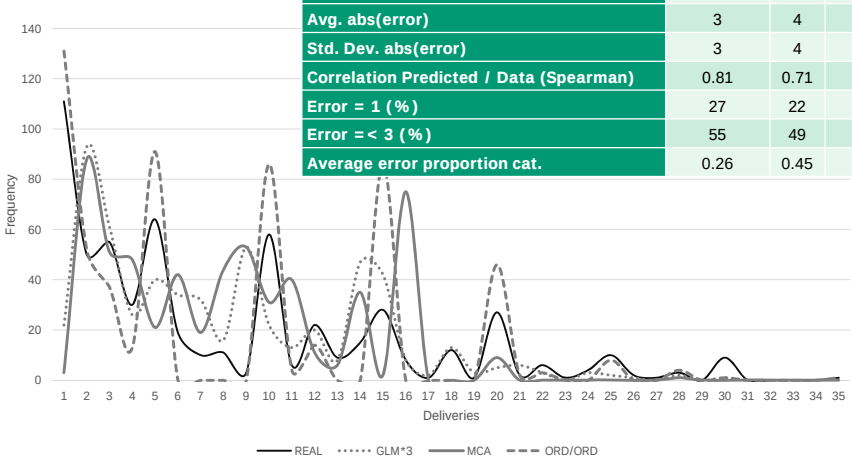
Comparison

	GLM*3	MCA	ORD/ORD
Correct	25%	8%	41%
RMSE	4	5	5
Avg. abs(error)	3	4	3
Std. Dev. abs(error)	3	4	4
Correlation Predicted / Data (Spearman)	0.81	0.71	0.79
Error = 1 (%)	27	22	23
Error =< 3 (%)	55	49	49
Average error proportion cat.	0.26	0.45	0.34



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Conclusions

- Employment and area-based models can provide models with acceptable explanatory power but modeling technique must not be selected lightly nor sample size compromised.
- The difference in estimations between models is considerable and a less adequate technique might change policy-analysis outcomes to an unknown extent.
- There is still room to explore other variables in this context (e.g., geo-spatial, supply-chain related). Data-collection with surveys is essential to explore these variables.
- Freight trip generation was found to be more dependent on the total of employees, rather than the establishment area, for most industry categories.

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Freight Trip Generation in the US: Summary of Findings

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- NCFRP 25 Report is published and available as NCFRP Report 19/ NCHRP Report 739

Introduction

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- The development of freight demand models for freight transportation is difficult due to:
  - Poorly understood system
  - Lack of proper balance: knowledge, models and data
- Freight generation (FG) and freight trip generation (FTG) are vital for freight demand models
  - Commodity based
  - Trip based
  - Tour based
  - Hybrid…

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SUSTAINABLE URBAN FREIGHT SYSTEMS

Key Findings

1. Freight Generation vs. Freight Trip Generation

- FG and FTG are two different things
  - Results of economic and logistics decisions
- Generation of demand, e.g., tons,
  - Economic manifestation of production/consumption
- Generation of traffic, e.g., truck trips
  - Generation of traffic is the result of logistical decisions

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SUSTAINABLE URBAN FREIGHT SYSTEMS

Conceptual relation between FG, FTG and size

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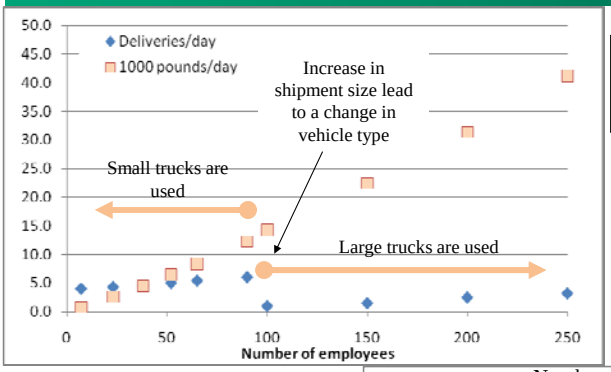
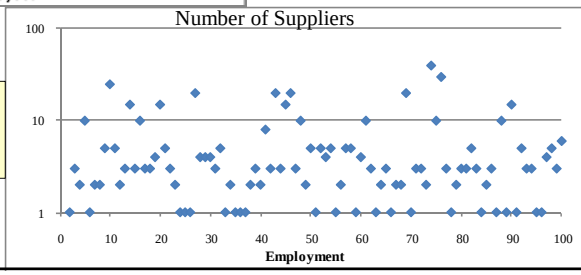


Larger shipment sizes can be handled with larger trucks
Indivisibility of truck trips

Wholesale trade
Constant number of suppliers



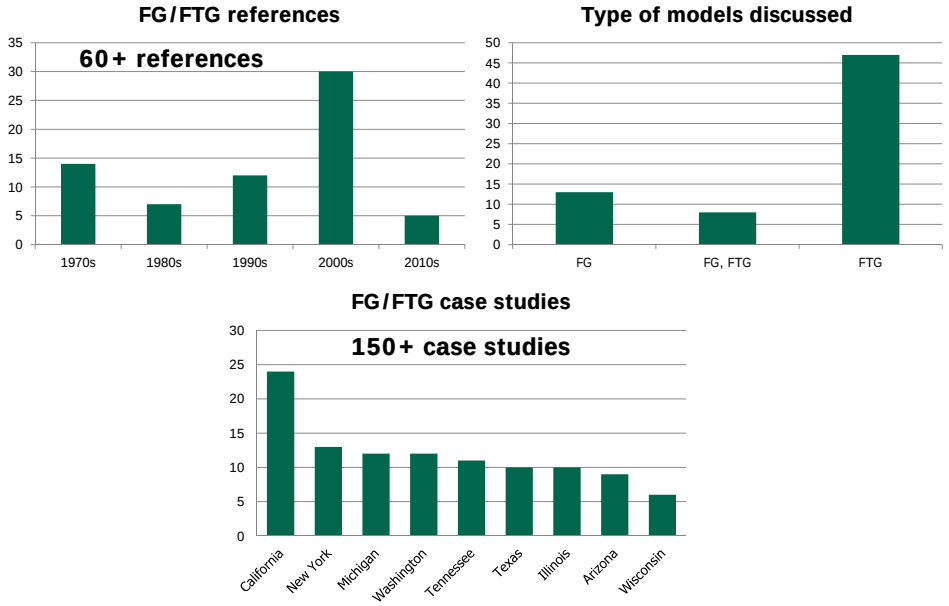
2. FTG Modeling Considerations

40

- The accuracy and validity of FTG is affected by:
  1. Determinant factors considered
  2. The statistical techniques used to estimate the models
     - Trip generation rates
     - Regression Analysis
     - Multiple Classification Analysis
  3. The classification system used to group the establishments
     - Economic Classification systems
       - Standard industrial classification (SIC) codes
       - North American Industry Classification System (NAICS)
     - Land Use Classification systems
       - The City of New York Zoning Resolution (NYCZR)
       - Land-Based Classification Standards (LBCS)

Determinant Factors Review

41



Variables used in FG/FTG modeling

42

- Variables used for FG/FTG modeling in the literature

Independent variable		Percentage
Area	786	41.59%
Employment	565	29.89%
Establishment	278	14.71%
Land use	211	11.16%
Household	47	2.49%
Other	41	2.17%
Fleet	36	1.90%

Independent variable		Percentage
Individuals	15	0.79%
Cargo	13	0.69%
Sales	5	0.26%
Industry segmen	2	0.11%
Traffic volumes	2	0.11%
Income	1	0.05%
Parking	1	0.05%

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SUSTAINABLE URBAN FREIGHT SYSTEMS

Case Studies in the US

- 2006 FTG data
  - Sample of receivers from Manhattan and Brooklyn
  - Sample of carriers from New York and northern New Jersey
- 2012 FTG data:
  - Sample of commercial establishments from Manhattan
- 2012 FTG CR data
  - Sample of commercial establishments in the capital region
- Mid-West Furniture Chain (MW-FC)
  - Sample of stores in 18 states from a furniture store chain
- NYC Grocery Stores (NYC-GS):
  - Sample from a grocery store chain in Manhattan
- Seattle Region Grocery Stores (SR-GS):
  - Small sample of supermarkets in the Puget Sound metropolitan area

FTA Models- Employment based

NAICS

NAICS		Trips/ Establishment
23	**Construction**	2.16
31-33*	**Manufacturing***	**2.83**
31	Food, Beverage, Tobacco, Textile, Apparel, Leather & Allied Product Manufacturing	2.40
32	Wood, paper, printing, petroleum & coal products, chemical, plastics, nonmetallic & mineral product manufacturing	4.42
33	Metal, machinery, computer, electronic, electrical, transportation, furniture & misc. manufacturing	2.49
45	Sporting goods, hobby, book, & music stores	2.72

NAICS		Wholesale trade (NAICS 42)	Retail trade (NAICS 44-45)	Reta ma	
Emp o_ yees	1-10	2.44	3.39		
	11-20	3.34	4.02		
	21-30	5.69	4.65	6.79	5.14
Regression Model		2.272+ 0.069*emp	3.070+0.063*emp	3.070+ 0.132*emp	1.307+ 0.081*emp

A small (1-10 emp.) wholesale establishment attracts 2.44 trips every day

FTP Models- Employment-based

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NAICS		Trips/ Establishment
31-33*	**Manufacturing***	**2.21**
31	Food, Beverage, Tobacco, Textile, Apparel, Leather & Allied Product Manufacturing	2.85
	al	1.75

A food manufacturing establishment produces 2.85 trips every day independent from its size

		Construction (NAICS 23)	chemical plastics, nonmetallic and miscelaneaous (NAICS 32)	Wholesale trade (NAICS 42)	Retail trade (NAICS 45)	tail:furniture, ronics, building material, food, beverage, clothing (NAICS 44)	Transport and warehousing (NAICS 48,49)
Employees	1-20	2.424	1.303	2.946	1.610	1.685	3.381
	21-40	1.727	0.606	2.564	4.830	1.303	2.998
	41-60	2.061	0.939	3.283	8.050	2.023	3.718
	61-80	4.061	2.939	2.764	11.270	1.504	3.199
	>80	5.121	4.000	7.609	14.490	6.348	8.043
Reg. Model		0.068*emp	0.023*emp	1.755+ 0.036*emp	0.161*emp	0.993+ 0.021*emp	2.718+0.038*emp

FTG Models- Area-based

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Description	FTA Area c	FTA Area b	FTP Area c	FTP Area b
Construction*	2.160			1.68
31	2.400		2.846	
32	4.420			0.57
33	2.490		1.750	
Manufacturing*	2.831		2.214	
Wholesale Trade*	2.272	1.70	1.755	0.89
44	2.458	3.27	0.993	0.52
45	2.724		n/a	
Retail Trade*	3.070	1.54		
48 Transportation and Warehousing*	n/a			
Accommodation and Food*	1.307	1.99		

c = intercept, b = slope, area in 1,000 square feet

A 5,000 sq. feet (464 sq. meters) wholesale establishment produces 6.2 trips in a typical day

Summary of FTA Models

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Group	Classification System	Code/Function	Description	Obs.	Const./Empl. c	Const./Empl. b	Best Model
Construction	SIC	15, 16, 17	Construction - group model	25	2.160		S
	NAICS	23	Construction sector	25	2.160		S
	LBCS	Construction; services; and other	Construction-related business; Communications and information; Education, public admin, health care, and other institutions.	32	3.919		S
Manufacturing	SIC	21-39	Manufacturing - group model	45	3.156		S
	NAICS	31, 32, 33	Manufacturing sector	51	2.831		S
	NYCZR	M1-1, M1-2, M1-2/R6A, M1-2D, M1-6, M3-1	Manufacturing districts	138	3.216		S
	LBCS	Textiles & Manufacturing	Manufacturing: Food, textiles, and related products; all other	38	3.130		S
Wholesale Trade	SIC	50, 51	Wholesale trade - group model	117	2.272	0.069	C
	NAICS	42	Wholesale trade sector	117	2.272	0.069	C
	LBCS	Wholesale Trade	Durable and nondurbale goods	114	2.640	0.062	C

Notes: Coefficients are statistically significant at 95% level
Model Types: S - Constant trip rate (c);
C - Combined linear model with intercept (c)and dependent on business size (b)

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Summary of FTA Models

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Group	Classification System	Code/Function	Description	Obs.	Const./Empl. c	Const./Empl. b	Best Model
Retail Trade	SIC	52, 53, 55, 56, 57, 59	Retail trade - group model	84	3.371		S
	NAICS	44, 45	Retail trade sector	98	3.070	0.063	C
	LBCS	Retail & Pharmacy	Pharmacy or drugstore; cosmetic and beauty supplies; business, professional, scientific, and technical services; all other retail	89	3.720		S
Food	SIC	20, 54, 58	Food stores, restaurants and bars	83	1.826	0.090	C
	NAICS	72	Accommodations and Food	56	1.307	0.081	C
	LBCS	Grocery & Food Service	Grocery store, supermarket or bakery; specialty food store; fruit and vegetable store; beer, wine and liquor store; food services	79	1.887	0.085	C
Commercial	NYCZR	C1, C4, C5, C6	Small retail & service shops: grocery stores, restaurants & beauty; large stores with general goods: specialty & department stores, theaters & other commercial and office uses.	115	2.760	0.063	C
		C2, C8	Small retail & service shops: same as C1 but permits funeral homes & repair services; heavy repair shops and automotive.	7	4.286		S
Residential	NYCZR	R6, R6A, R6B, R7-1, R7-2, R7A, R8	Residential Districts	10	2.660		S

Notes: Coefficients are statistically significant at 95% level
Model Types: S - Constant trip rate (c);
C - Combined linear model with intercept (c)and dependent on business size (b)

Model Performance

- The economic based classifications systems provide more efficient models

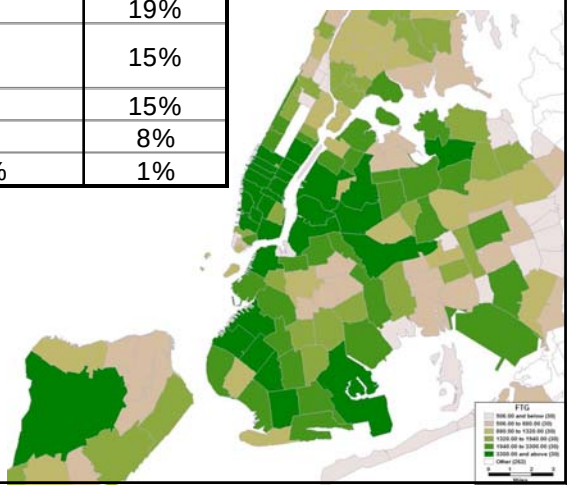
Classification System	RMSE
SIC	3.332
NAICS	3.566
NYCZR	4.205
LBCS	4.529

Using models estimated with 2006 FTG Data

- MCA models outperform OLS/Rates
  - At the expense of more data

Applying FTG models to New York City

	Establishments	Deliveries
Retail	14%	42%
Wholesale	8%	19%
Accommodation and food	8%	15%
Construction	9%	15%
Mannufacturing	3%	8%
Others	57%	1%



3. Perils of Using Constant FTG per Employee

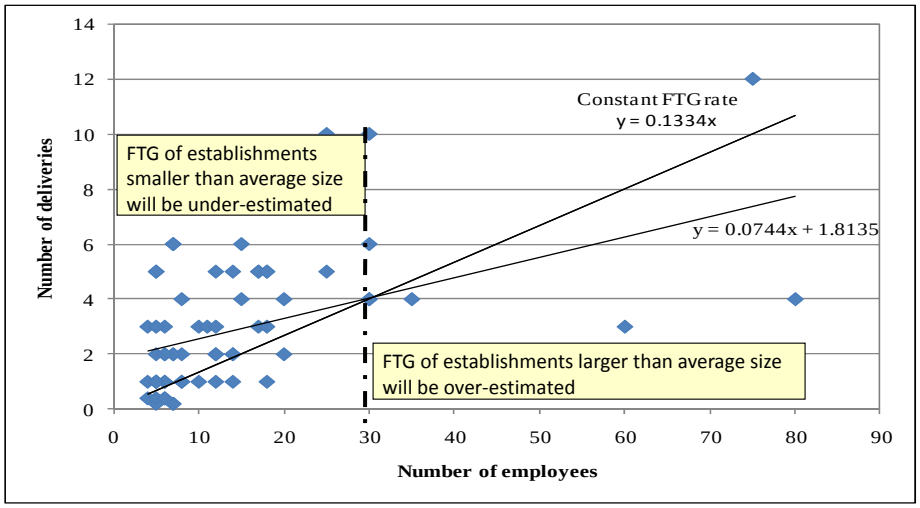
	Type S: Constant FTG per Establishment		Type E: Proportional to number of employees		Type C: Combined model with intercept and rate per employee		Total
	Cases	%	Cases	%	Cases	%	
SIC	12	57%	5	24%	4	19%	21
NAICS	6	60%	0	0%	4	40%	10
NYC Land-Use	13	72%	4	22%	1	6%	18
LBCS	4	80%	0	0%	1	20%	5

Results are consistent → in most cases FTG is constant

Using FTG rates as a function of a single independent variable (e.g., employment) may not be universally valid

Practical Implications

- Effects of using constant FTG rates for SIC 51 (Wholesale Trade: Non-durable goods).



4. FTG Models are Transferable

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- The analysis considers industry segments where:
  - NCFRP 25, QRFM, and ITE provide models
- Two approaches to assess transferability:
  - (1) Application of the models to estimate FTG for establishments where the FTG is known
  - (2) Pooled data is used to estimate econometric models that include location specific binary variables

Assessment of Transferability: (1)

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Classification	Description	Validation Data							RMSE		
		Sample Size	Mean Employ-ment	NYS-CR	NYC	NYC-GS	MW-FC	SR-GS	NCFRP 25	QRFM	ITE
NAICS 72	Accomodation/Food	5	5.8	x					1.26	6.51	n/a
LBCS	Function Food Service	5	5.8	x					1.26	6.51	n/a
ITE 816	Hardware/Paint Stores	8	10.0		x				1.67	1.99	2.04
LBCS	Activity Restaurants	5	5.8	x					1.93	6.51	n/a
ITE 890	Furniture Stores	14	10.0		x				2.09	4.31	3.18
LBCS	Function Retail	13	8.9	x					2.55	22.46	n/a
ITE 890	Furniture Stores	58	8.9				x		3.42	5.60	1.25
ITE 860	Wholesale Markets	102	17.2		x				3.66	12.23	11.66
SIC 56	Apparel/Accessory	10	10.2	x					4.05	23.25	n/a
NAICS 44	Grocery Stores	7	15.3					x	4.10	32.06	n/a
SIC 58	Eating/Drinking Places	5	5.8	x					4.14	6.51	n/a
SIC 52	Building Materials	6	18.8	x					4.42	36.14	n/a
LBCS	Activity Goods	21	13.0	x					4.56	23.81	n/a
SIC 54	Food Stores	8	19.5	x					5.09	26.04	n/a
NAICS 44	Grocery Stores	30	78.0			x			7.08	41.73	n/a
NAICS 44	Retail Trade	21	55.0	x					8.02	23.42	n/a
LBCS	Function Grocery	8	19.5	x					13.89	26.04	n/a

NYS-CR: New York State Capital Region data; NYC: New York City data; NYC-GS: New York City Grocery Stores data; MW-FC: Mid-West Furniture Chain data; SR-GS: Seattle Region Grocery Stores

Assessment of Transferability: (2)

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- Furniture chain in Midwest and Northeastern states
  - Observations: 58
  - Variables: 5 locational variables (Illinois, Ohio, Michigan, Midwest States, and Northeastern States), type of establishment (conventional, outlet or combo), employment and interactions
  - Fixed effects model is: FTA=1.10 + 0.90 z1 + 0.04(E*s1)
    R^2 adj.=0.47 (23.20) (7.03) (2.36)
  - Where:
    - FTA: Freight Trip Attraction per day
    - E: Number of employees on a typical day
    - z1: The establishment is a combo stores
    - s1: The establishment is located in Michigan

Only one locational variable (Michigan) is statistically significant

Assessment of Transferability: (2)

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- Retail grocery stores in New York City and Seattle
  - Observations: 37
  - Variables: 2 locational variables (New York and Seattle), employment and interactions
  - Fixed effects model is: FTA=4.74 + 0.09E
    R^2 adj.=0.42 (3.22) (5.23)
  - Where:
    - FTA: Freight Trip Attraction per day
    - E: Number of employees on a typical day

None locational variable is statistically significant: Same model work for NY and Seattle

5. The Role of Freight Intermediaries

- Pure receivers, those that only receive goods
- Intermediaries, those that receive and ship goods

Industry sector		NAICS	Interme-diaries
Manufac-turing	Light manufacturing	31	58%
	Apparel	315	71%
	Medium manufacturing	32	67%
	Heavy manufacturing	33	80%
Wholesale trade		42	57%
	Nondurable goods	424	55%
Retail trade	Furniture, food, beverage, tobacco, textile and others	44	42%
	Furniture	442	67%
	Food and beverage	445	27%
	Health and personal	446	22%
	Clothing	448	54%
	Wood, paper, printing, chemicals	45	45%
	Miscellaneous	453	39%
	Nonstore	454	57%
Arts, entertainment, and recreation		71	46%
Accomodation and food services		72	33%
	Accommodation	721	50%
Other services (except public administration)		81	24%
Grand Total			46%

Practical Implications

- Estimating aggregate FTG:

NAICS	Description	Naïve RMSE	Correct. Factor RMSE	Logit Model RMSE
31	Light manufacturing	4.99	4.02	4.32
32	Medium	12.69	5.65	8.34
33	Heavy manufacturing	5.37	4.86	5.00
42	Wholesale trade	15.49	15.45	15.45
44	Retail food and others	1.82	1.53	1.54
45	Retail wood and others	3.90	3.62	3.73
71	Arts and entertainment	0.70	0.56	0.48
81	Other services	1.85	1.32	1.17

Binary Logit Model

Discrete Continuous Model

External Dataset	NAICS	Description	Naïve RMSE	Discrete Conti-nuous RMSE	Discrete Conti-nuous Model (2-digit NAICS) RMSE
NY-CR	44	Retail food and others	2.36	n.a.	2.16
2006	23	Construction	1.40	1.52	1.44
2006	31	Light manufacturing	2.68	1.97	1.76
2006	33	Heavy manufacturing	77.07	2.75	57.47
2006	42	Wholesale trade	3.99	3.12	2.56
2006	44	Retail food and others	1.57	4.67	1.16
2006	45	Retail wood and others	3.89	1.27	0.93
2006	All sample *		20.35	3.23	15.12

** Includes all NAICS in the sample*

Conclusions

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- It is important to understand the underlying behavior of the process we are modeling to:
  - Handle the data
  - Use the right modeling technique
  - Consider important variables
  - Extract knowledge
- Economic classification systems are a better proxy to the intensity/type of activity performed by establishments than land use based systems
- Employment based models can provide good estimates (models have low explanatory power)

Conclusions

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- NCFRP 25 models perform better than the Quick Response Freight Manual and ITE models
  - ITE will include one chapter with NCFRP 25 FTG models
- FTG models were found to be transferable to other geographic contexts

CHALMERS

SUSTAINABLE URBAN FREIGHT SYSTEMS

Key Findings on FTG Studies

FTG Studies

- Studying FTG patterns is key to understand urban freight
- Series of webinars on FTG:
  - Developing countries: Chennai, India; Medellin, Colombia
  - Developed countries: Lisbon, Portugal; New York City, USA
- These FTG Studies...
  - Are based on establishments surveys
  - Study trips attracted and produced
  - Use industry classification systems to group establishments
  - Focus primarily on retail and food services
  - Use employment as explanatory variables

FTG Studies

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- A grocery store in NYC has same FTA than in Seattle (about 5 daily deliveries)
- A typical retail establishment has similar FTA in Chennai (1.9 trips/day) and in Medellin (1.8 trips/day)

Sector	FTA - Chennai				NCFRP 25 – New York			
	N	c	b	R^2	N	c	b	R^2
Retail	73	1.88	-	-	73	3.682	-	-
Food	33	2.24	0.03	0.26	55	1.307	0.081	0.22
Miscellaneous 1	25	2.08	0.02	0.17	26	3.254	-	-

- [Small ~ 10 employees] food related establishments in Chennai, Lisbon and New York attract about the same number of deliveries (2 – 2.5 del/day), while in Medellin they attract about 1 daily delivery.

FTG Studies

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- There are differences in the types (sizes and capacities) of vehicles used for urban distribution
- Explanatory power of most FTG models is still very low
- Fortunately, the increasing interest in collecting FTG data across the world provides a fantastic opportunity to enhance the transportation community's understanding of this important and understudied subject

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Thank you!
Questions?

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