

Residential freight trip generation: A review of current methods and datasets

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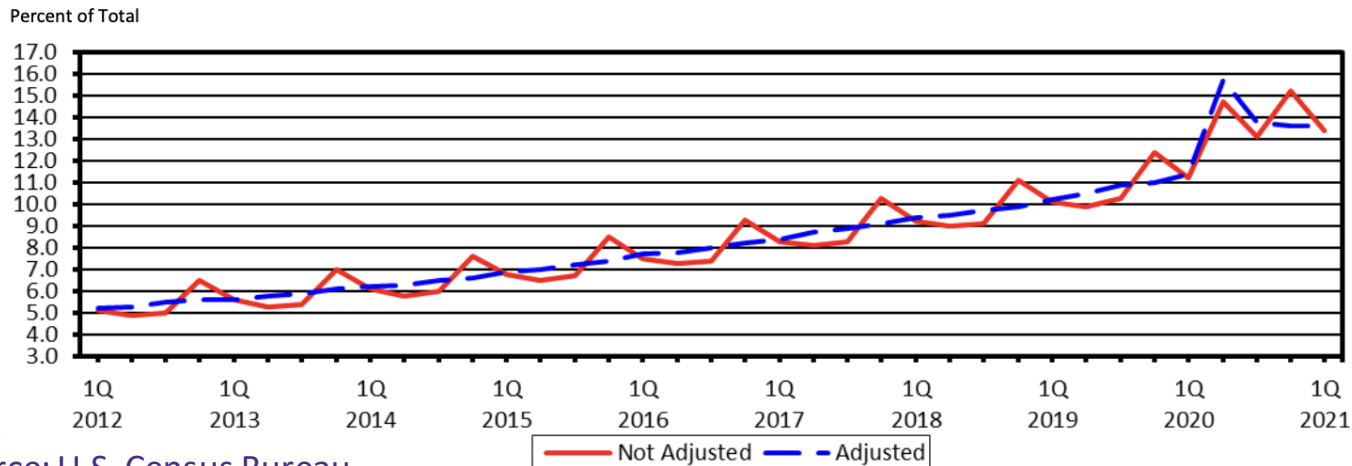
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Introduction - E-commerce

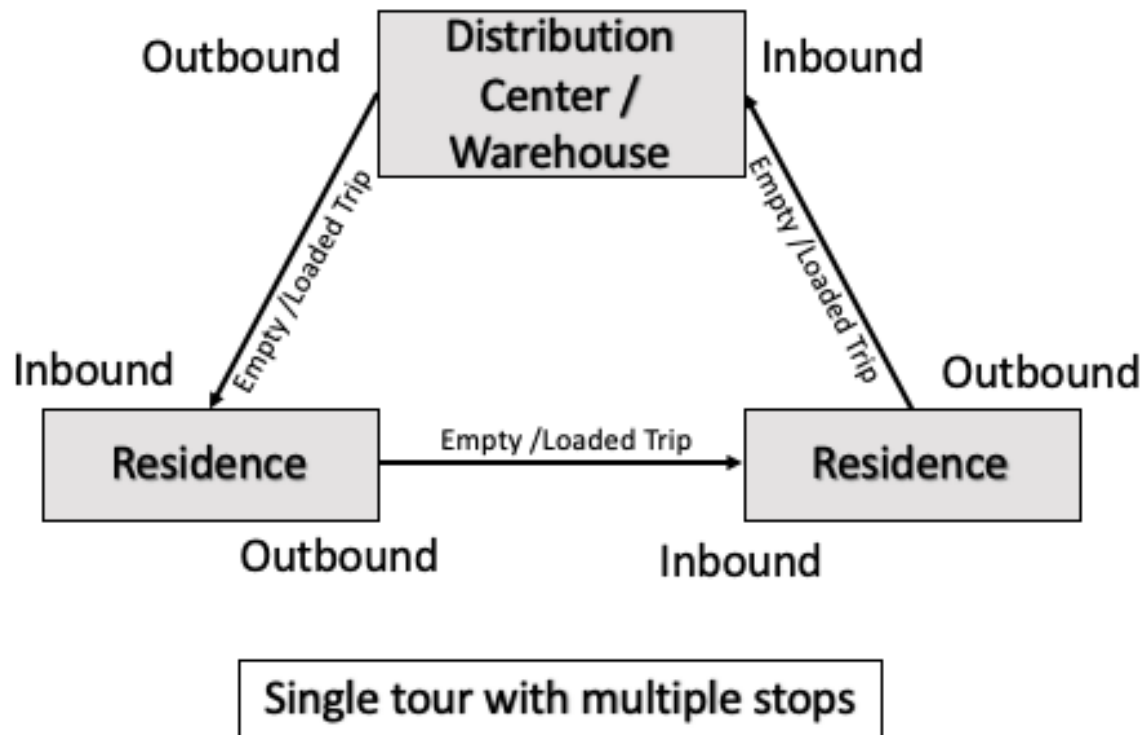
- > Increase of online shopping
- > Effects of the e-commerce increase:
 - Short-term - increase of freight volumes
 - Long-term - change of mobility patterns of passenger transport, the location and type of physical shops, and the establishment of warehouses closer to customers

Estimated Quarterly U.S. Retail E-commerce Sales as a Percent of Total Quarterly Retail Sales:
1st Quarter 2012 – 1st Quarter 2021



Introduction - Freight Trip Generation (FTG)

- > Freight Trip Attraction (FTA)
- > Freight Trip Production (FTP)



Goal

The goal of this study is to:

- > create an inventory of the current practices for the estimation of residential FTG and
- > highlight opportunities of improvement of current methodologies.



Literature Review

- > **Residential FTG models draw on the methods commonly used to estimate commercial freight trips.**
- > **While few studies focus on residential FTG, we examine a sample of the many studies on estimating commercial freight trips to understand:**
 - **context**
 - **challenges**



Literature Review – Commercial FTG

Commercial FTG estimation is used for identifying:

- > Freight flows**
- > Number of trips**
- > Consumer behavior**
- > Policy suggestions**



Literature Review – Commercial FTG cont'd

Independent Variables

Firm size¹
Land use²
Land-market value
Distance to truck route
Economic activity
Commodity type³

Dependent Variables

Number of FTA and FTP
Number of vehicle movements

Data Sources

NAICS
ITE
SIC
FTG surveys
Interviews
Traffic counts

1. Iding, et al. Freight Trip Generation by Firms. 2002.

Oliveira, et al. Analysis of Freight Trip Generation Model for Food and Beverage in Belo Horizonte (Brazil). 2017

2. Holguín-Veras, et al. Freight Generation, Freight Trip Generation, and Perils of Using Constant Trip Rates. 2011.

3. Alho, et al. Freight-Trip Generation Model Predicting Urban Freight Weekly Parking Demand. 2014.



Literature Review – Commercial FTG cont'd

Most models produce constant FTG rate estimations, and the rest are linear models related to the number of employees. (Puente-Meija et al., 2020)

Different methods appropriate for different datasets and land-use classification (Alho and Silva, 2014)

There is a significant trip rate variation every five years. (Currans and Clifton, 2018)

More disaggregated data can improve the quality of constant FTG rates. (Gonzalez-Feliu and Sanchez Diaz, 2019)



Residential FTG methodologies

Package-based FTG estimates

Source	Values			Application
Chen et al., 2017 (15)	Commercial tract: 20 Packages/ day	Mixed-use tract: 322 Package/ day	Residential tract: 403 Package/ day	Parking regulations and behavior for residential deliveries



Residential FTG methodologies

Delivery-based FTG estimates

Source	Values			Application
Wang & Zhou, 2015 (5)	0.43 deliveries per person/month			Understand the pattern of residential freight trips
Cardenas et al., 2017 (35)	Urban: 0.33 deliveries-day/thousand habitants	Semi-urban: 0.72 deliveries-day/thousand habitants	Rural: 0.91 deliveries-day/thousand habitants	Calculate external cost delivery index
Jaller et al., 2015 (28)	2.66 deliveries/day			Identify LTG
Middela & Ramadurai, 2020 (36)	0.98 deliveries per establishment/month			Improve spatial FTG modelling
SCAG, 2020 (37)	Residential major: 2.3 deliveries per block/day	Residential minor: 1.2 deliveries per block/day		Increase understanding of last-mile delivery issues



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Residential FTG methodologies

Online purchase based FTG estimates

Source	Values	Application
Zhou & Wang, 2014	2.277 online purchases in the past month	Relationship between online shopping and shopping trips
Weltevreden & Rotem-Mindali, 2009	7.627 online purchases per e-shopper per year	Impacts of B2C and C2C e-commerce on freight and personal travel



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Residential FTG data sources

Temporal characteristics

Categories	Source	Dataset	Dataset Year	Data timeline
Number of packages	Chen et al., 2017	Household Diary Study, USPS	2012	Week
Number of deliveries	Wang & Zhou, 2015	NHTS	2009	Week
	Cardenas et al., 2017	Parcel delivery company data	2015	4-month time window
	Jaller et al., 2015	Establishment based survey, New York State Capital Region	2006	-
	Middela & Ramadurai, 2020	Establishment based survey, Chennai	-	-
	SCAG, 2020	Los Angeles County Assessor's data and Parcel delivery data	2019	-
Number of online purchases	Zhou & Wang, 2014	NHTS	2009	Week
	Weltevreden & Rotem-Mindali, 2009	Own data (Travel Survey, Netherlands)	2006	30 August - 19 September



Discussion

Comparable estimates

- **Zhou & Wang: 1 delivery per person per month**
- **Cardenas et al.: 0.01 deliveries per person per month**
- **Weltevreden & Rotem-Mindali: 0.2 deliveries per person per month**

Assumptions:

- **online purchase translates to 1 package**
- **2 packages are delivered per trip (Aljohani and Thompson)**



Discussion cont'd

Survey data

- Expensive to collect
- Based on the methodologies applied for the commercial FTG estimation

Location data

- Available worldwide
- Current and continuous patterns of travel behavior
- Seasonal changes
- E-commerce trends



Conclusions

The opportunities for improvement of the existing residential FTG estimates are:

- > Application of estimates that are not static and in similar geographies and spatial scales.**
- > Improve data currency.**
- > Use uniform units of the estimates.**
- > Show forecast period.**
- > Show seasonality.**



Suggestions for the future

Work together to improve residential FTG estimates.

- > Use of widely available geospatial data with spatial/temporal specificity.
- > Introducing updated datasets that can capture the temporal and spatial variability of residential deliveries.
- > Data should be used in as real-time a manner as possible, and forecasting should be considered an ongoing task.
- > Validation efforts should inform the estimate of a forecast's validity, and the applicability of the estimate spatially and temporally.



Thank you!

Questions

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