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Innovation and System Information

Research



Results



Planning, Policy,
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Analytical Modeling Framework to Assess the Economic and Environmental Impacts of Residential Deliveries, and Evaluate Sustainable Last-Mile Strategies

Develop an analytical framework to model urban last mile delivery which build upon the econometric behavior models that capture e-commerce demand.

WHAT WAS THE NEED?

In the last decade, e-commerce has grown substantially, increasing business-to-business, business-to-consumer, and consumer-to-consumer transactions. As a result, there has been a continuous growth in last mile operations, especially deliveries to residential areas, bringing along externalities such as congestion, air and noise pollution, and energy consumption. This study aimed to develop an analytical framework to model last mile operations based on continuous approximation techniques.

WHAT WAS OUR GOAL?

The model helped estimate the economic and environmental impacts of residential deliveries, from a growth perspective, and through comparative analyses between consumer decisions (e.g., trip complementarity and substitution, trip-induced demand). The model estimated the impacts for freight operators (shipper, and carriers), and the community.

Based on data from the National Household Travel Survey, and the American Time Use Survey, the researchers conducted empirical analyses with the modeling framework. Moreover, to contend with the transportation issues, the team evaluated a number of scenarios involving city logistics strategies such as the introduction of cargo consolidation facilities (CF), alternative delivery points, and the use of cargo bikes and zero emission vehicles for the last mile.



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WHAT DID WE DO?

This study further developed the understanding of the impacts of city logistics strategies to contend with the negative consequences of these delivery trends. The analytical framework can be used in different geographic locations, especially in dense urban areas, to estimate the various impacts (under a different set of inputs).

WHAT WAS THE OUTCOME?

The study found significant benefits from out-sourcing delivery, either in the form of customers picking up their packages at the collection points or by crowd-sourcing deliveries. In particular, the results show the benefits (reduced operating costs) of out-sourcing delivery, though these benefits may be realized at the expense of social costs in the form of additional externalities. However, under specific settings, out-sourcing deliveries can operate sustainably, as discussed by Odongo (2018) for the case of crowd-sourced deliveries.

In particular, the study found that crowd-sourcing deliveries can produce significant gains for the e-retailer and at the same time reduce externalities when temporal constraints are binding, and capacity constraints are not. Although strict working conditions in the case with short time-windows may dissuade crowd-shippers in taking up delivery responsibilities, thus reducing driver supply (Ermagun et al., 2019).

WHAT IS THE BENEFIT?

The objective of this research is to develop an analytical modeling framework to assess the economic and environmental impacts of residential deliveries. The researchers have identified the most important factors from

e-commerce and residential delivery strategies and incorporated them into the framework. Considering the complexity to explicitly model these factors, the analytical framework is based on continuous approximation techniques.

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<https://escholarship.org/uc/item/4143j4pr>

IMAGES

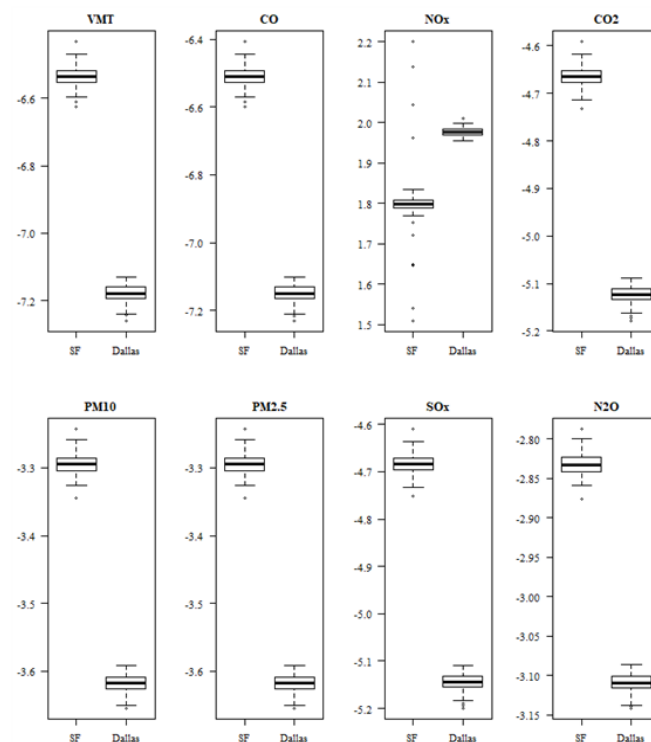


Figure 1 Comparison of Omni-channel with In-store Shopping (% change)

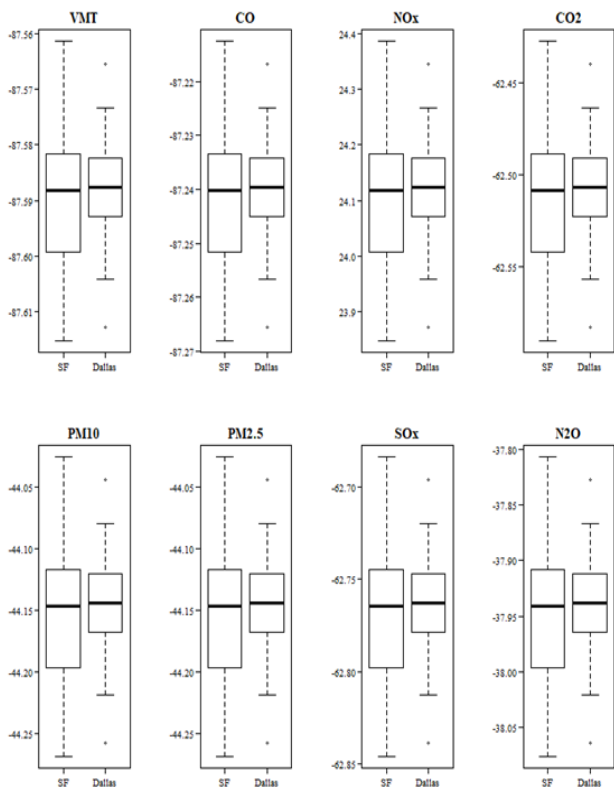


Figure 2 Comparison of Online with In-store Shopping (% change)

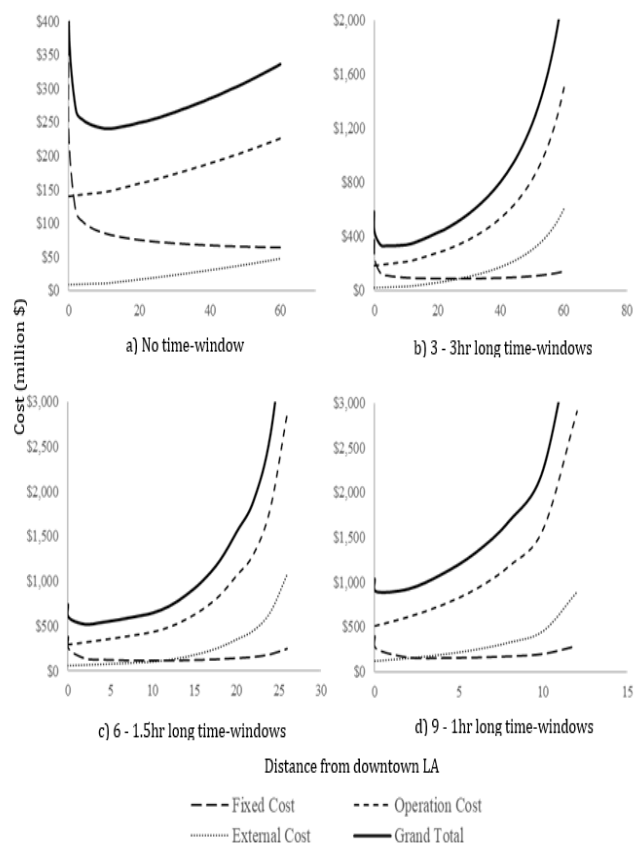


Figure 3 The Cost Trade-offs and Impact of Time-windows

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