TRB

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INTRODUCTION

Establishing the association between the built environment and the travel behavior of households can **increase the sensitivity of travel demand models** to the specifically locational characteristics individual households and trip-makers.

Limitation of past research:

- Most investigations with respect to trip generation consider the frequency of trips by specific mode of travel.
- The built environment played a less important role in trip frequency estimation than in trip length estimation.

Overall, there is a lack of consensus the role the built environment may play in trip generation rates, and much of the research on this question are dated.

OBJECTIVES

This research proposes new model estimations of household trip generation rates based on socio-demographic and built environment variables. The paper attempts to answer two questions:

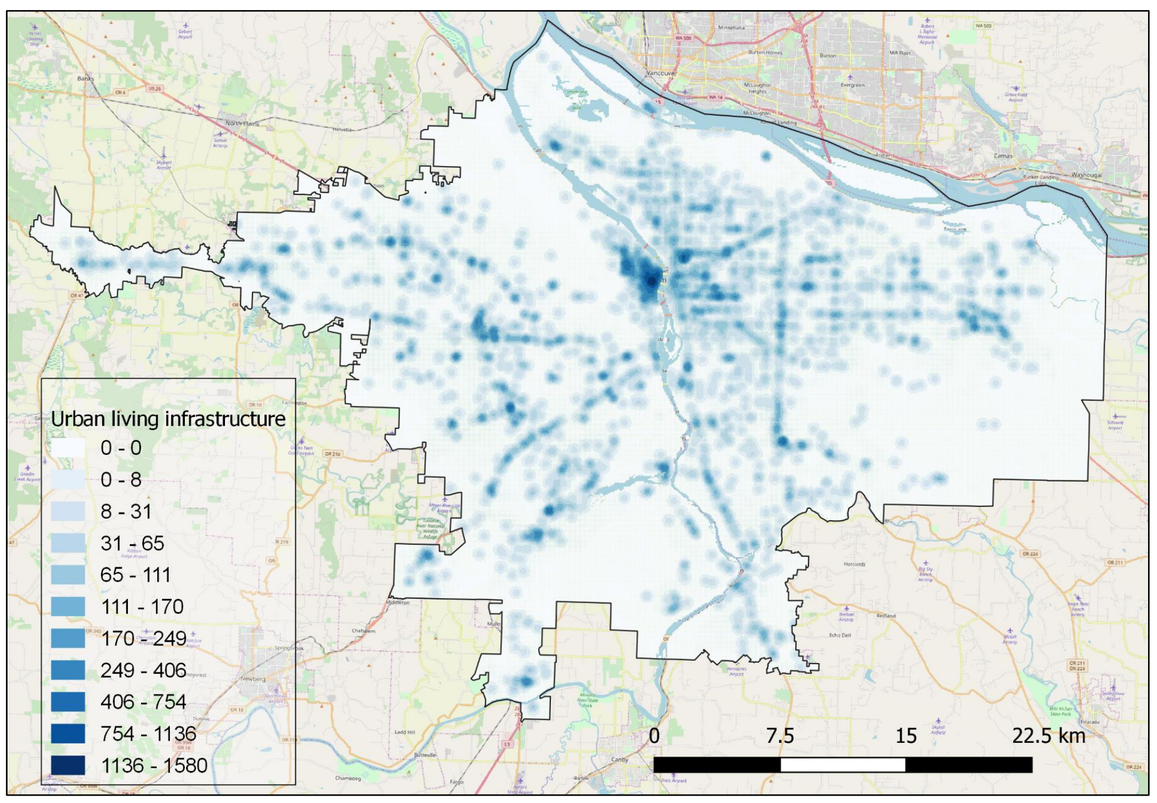
? **Does the built environment have significant impacts on household total trip generation?**

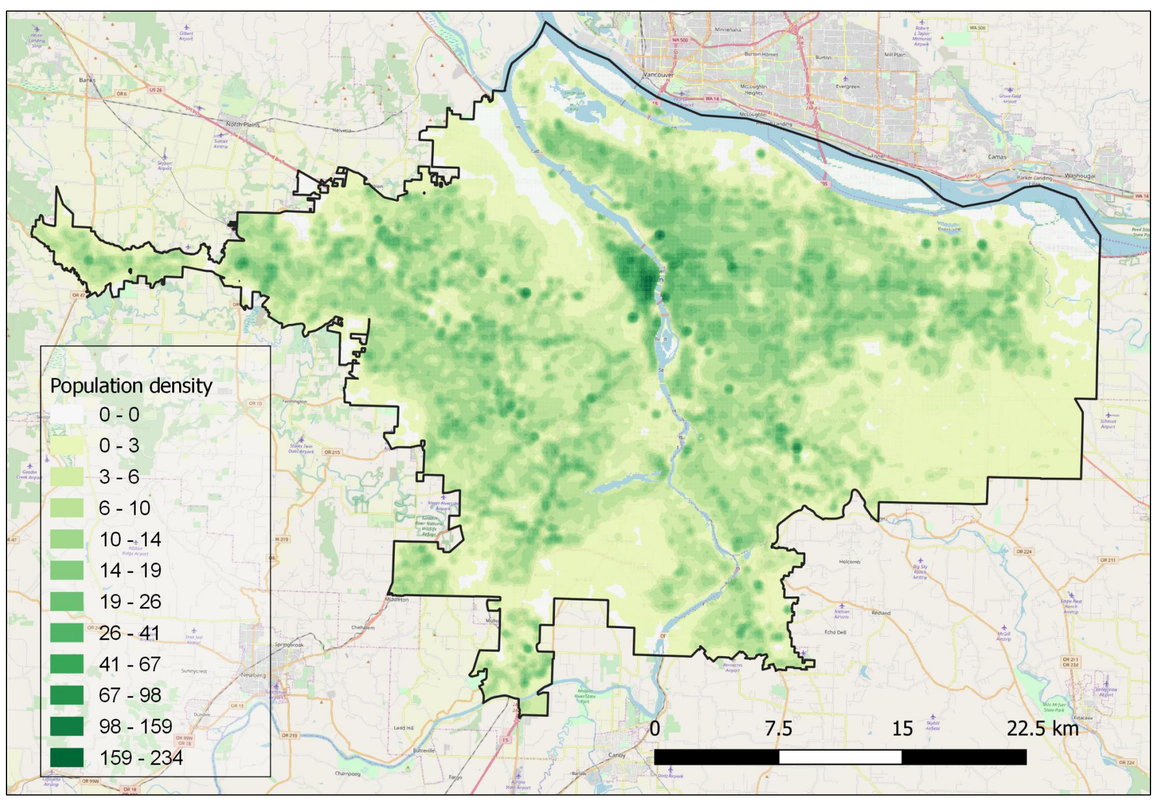
? **If yes, which trip purposes are more elastic to the built environment?**

DATA AND METHOD

- **Study area:** Portland metropolitan region
- **Data source:**

1) 2011 Oregon Household Activity Survey (OHAS) with 4,328 households.
2) Household density and Urban Living Infrastructure (ULI) data are provided at a scale of 80 m x 80 m by Portland Metro.





- **Method:**

1) Negative binomial regression model for total number of trips, total number of tours, average number of stops per tour
2) Zero-inflated negative binomial model for HBWork, HBEducation, HBShop, HBRecreation and HBOther trip rates.

European Commission

IAS

Household Trip Generation and The Built Environment

Does **MORE DENSITY** mean **MORE TRIPS?**

RESULT

More Density, More Total Trips/Tours

- Households with more workers, more school-aged students, more cars and medium to high income tend to generate more total trips/tours.
- People who live in denser neighborhoods are more likely to generate more trips/tours.

	Estimate	Pr(>|z|)
Dependent variable - number of trips per household		
Intercept	0.962	<0.001 ***
Number of workers	0.322	<0.001 ***
Number of non-workers	0.266	<0.001 ***
Number of teleworkers	0.052	0.005 **
Number of children under 6 years	0.111	<0.001 ***
Number of school students	0.117	<0.001 ***
Number of vehicles	0.035	<0.001 ***
Medium-high income household (Yes)	0.129	<0.001 ***
Ln(household density within one mile)	**0.032**	**<0.001 ** **
Urban living infrastructure	**0.0002**	**0.097 .**

*Expanded model with built environment variables has a better goodness-of-fit.
Log likelihood ratio is 16.23 at a 99.9% significant level.

	Estimate	Pr(>|z|)
Dependent variable - number of tours per household		
Intercept	-0.172	0.032 *
Number of workers	0.321	<0.001 ***
Number of non-workers	0.259	<0.001 ***
Number of children under 6 years	0.071	0.019 *
Number of school students	0.130	<0.001 ***
Number of vehicles	0.025	0.014 *
Medium-high income household (Yes)	0.148	<0.001 ***
Ln(household density)	**0.046**	**<0.001 *** **
Urban living infrastructure	**0.0002**	**0.264**

*Expanded model with built environment variables has a better goodness-of-fit.
Log likelihood ratio is 21.75 at a 99.9% significant level.

More Density, More Mandatory Trips (Work and education)

- As expected, number of workers contributes the most in HBW trip rates, while HBE trip rates mainly depends on the kid status in the household.
- The workers/students who live in the denser areas are likely to generate more HBW/HBE trips, possibly resulting from trips to have lunch at home.

	Estimate	Pr(>|z|)
Dependent variable - number of home-based work trips		
Step 1: Zero-inflation model coefficients (binomial with logit link)		
Intercept	3.369	<0.001 ***
Number of workers	-5.460	<0.001 ***
Step 2: Count model coefficients (negative binomial with log link)		
Intercept	-0.288	0.024 *
Number of workers	0.307	<0.001 ***
Number of vehicles	0.047	0.002 **
Medium-high income household (Yes)	0.158	<0.001 ***
Ln(household density)	**0.033**	**0.053 .**
Urban living infrastructure	**n.s.**	**n.s.**

*Expanded model with built environment variables has a better goodness-of-fit.
For home-based work model, log likelihood ratio is 3.81 at a 90% significant level.
For home-based education model, log likelihood ratio is 5.73 at a 95% significant level.
*n.s. means not significant.

	Estimate	Pr(>|z|)
Dependent variable - Number of home-based education trips		
Step 1: Zero-inflation model coefficients (binomial with logit link)		
Intercept	7.088	<0.001 ***
Number of children under 6 years old	-8.323	<0.001 ***
Number of school students	-9.892	<0.001 ***
Number of college students	-7.456	<0.001 ***
Step 2: Count model coefficients (negative binomial with log link)		
Intercept	0.065	0.670
Number of workers	0.037	0.068 .
Number of children under 6 years old	0.384	<0.001 ***
Number of school students	0.411	<0.001 ***
Number of college students	0.037	0.251
Number of vehicles	0.052	0.004 **
Ln(household density within one mile)	**0.050**	**0.017 ***
Urban living infrastructure	**n.s.**	**n.s.**

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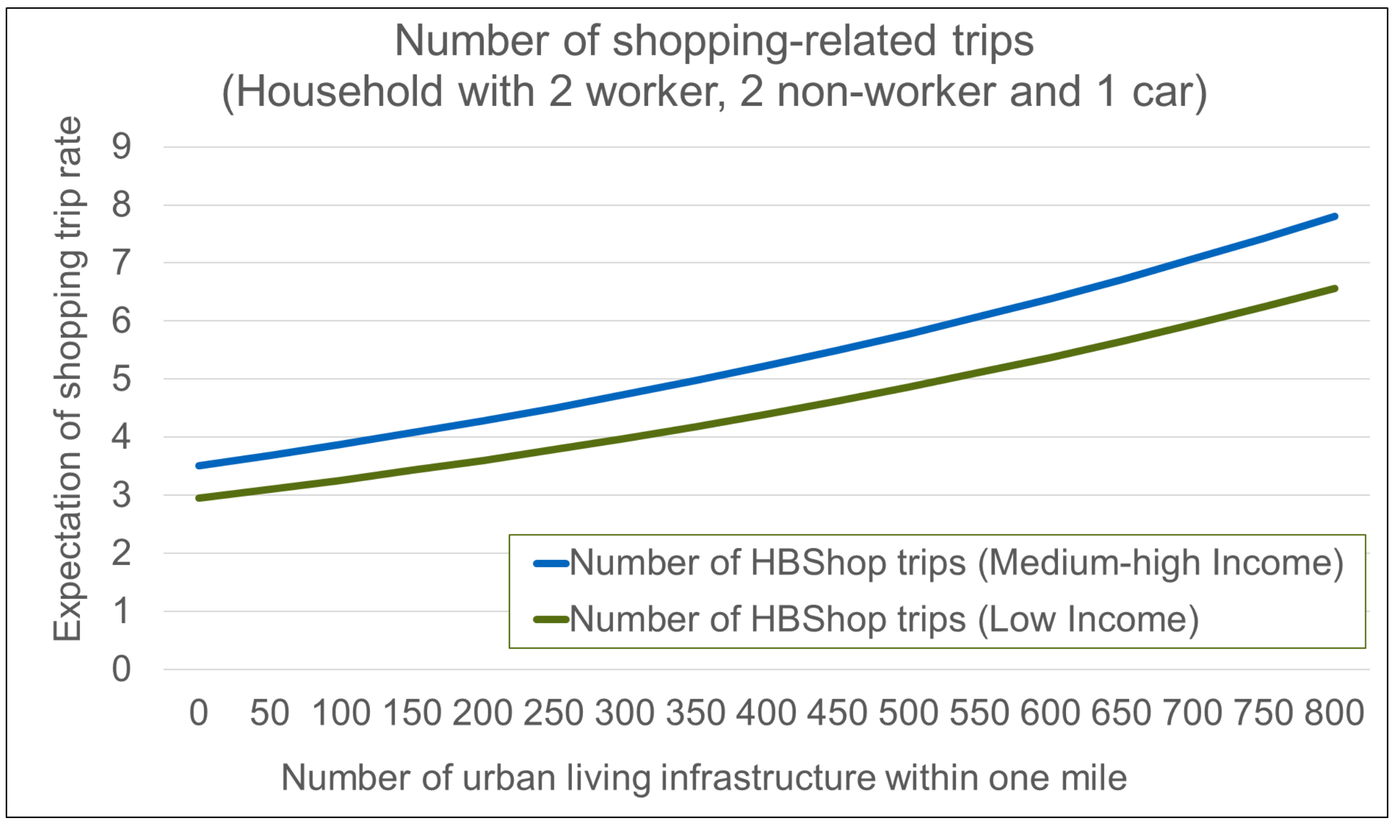
RESULT

Shopping-related trips is more elastic to local accessibility

- Non-workers show higher shopping-related trip rates than workers.
- Households with more vehicles and medium to high income tend to generate more shopping-related trips.
- Households living in the neighborhoods with higher local accessibility tend to make more shopping trips.



	Estimate	Pr(>|z|)
Dependent variable - Number of home-based shopping trips at the household level		
Step 1: Zero-inflation model coefficients (binomial with logit link)		
Intercept	-1.588	<0.001 ***
Number of workers	0.125	0.024 *
Step 2: Count model coefficients (negative binomial with log link)		
Intercept	0.236	<0.001 ***
Number of workers	0.105	<0.001 ***
Number of non-workers	0.287	<0.001 ***
Number of vehicles	0.062	<0.001 ***
Medium-high income households (Yes)	0.173	<0.001 ***
Ln(household density within one mile)	**removed**	**removed**
Urban living infrastructure	**0.001**	**<0.001 *** **

*Expanded model with built environment variables has a better goodness-of-fit. Log likelihood ratio is 20.80 at a 99.9% significant level.
*Household density was removed since it showed a high multicollinearity in VIF test.

CONCLUSION

The **main findings** of the research are:

- **Households living in the densely-populated neighborhoods** tend to **make more trips and more tours** than those living in neighborhoods with average population density in the suburban areas.
- **Households living in less-populated areas** are **more likely to bundle several trips into one tour**, which gives us a better understanding of trip chain making in activity-based models.
- **Local accessibility matters the most for shopping-related trips** among the five observed trip purposes.

Overall, built environment variables have **significant but moderate impacts** on household trip generation.

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