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Examining the Role of Neighborhood-level Attributes and Service Characteristics in Microtransit Use

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Introduction

- Microtransit
  - Technology enabled shared public transportation service
  - Smartphone application
    - trip requests
    - real time vehicle tracking
    - fare payment
  - Flexible routing and pick-up/drop-off
  - Algorithm dependent

Literature Review

- Studies have conducted *qualitative analysis* of microtransit systems.

  (Ghimire et.al, 2023; Lucken et.al, 2019; Jokinen, 2019)

- Some studies utilize *stated and revealed preference surveys* on microtransit use.

  (Rossetti et.al, 2023; Rossetti et.al, 2024 :Yan et.al, 2021; Macfarlane, 2020)

- Yet to observe studies that utilize *empirical trip data* to better understand the determinants of microtransit demand.

Research objectives

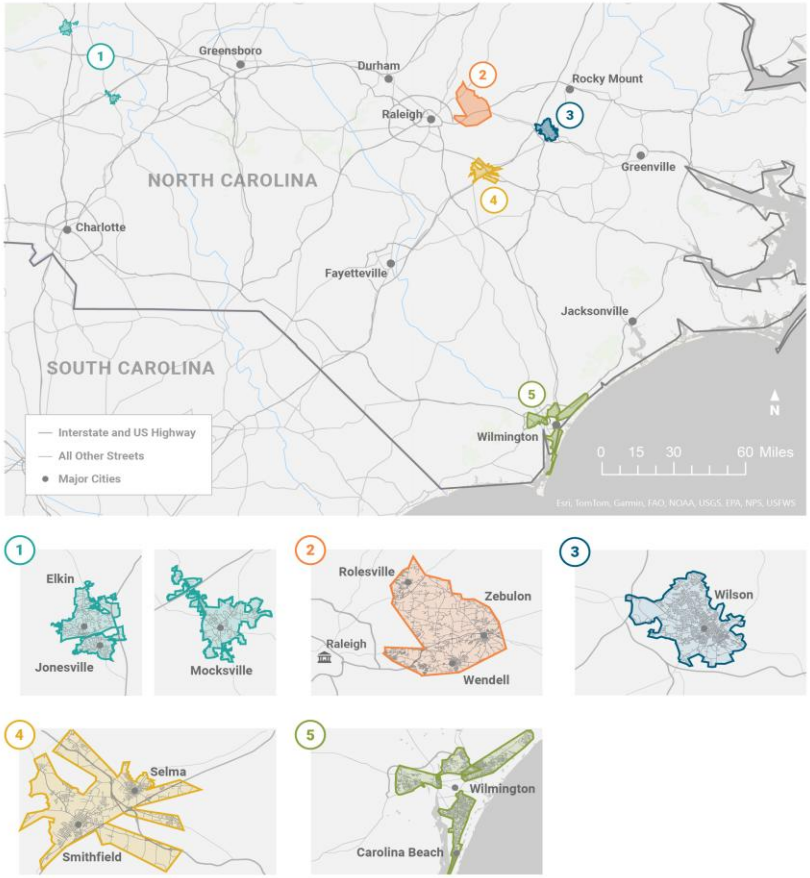
- Understand the socioeconomic and built environment factors contributing to higher use of microtransit services.
- Study the variability of these factors in different microtransit systems.
- Examine the role of critical service attributes on microtransit use.

Research contributions

- First study to comprehensively study determinants of microtransit demand from multiple microtransit systems.
- Improved understanding of service characteristics associated with higher demand.

Microtransit study areas

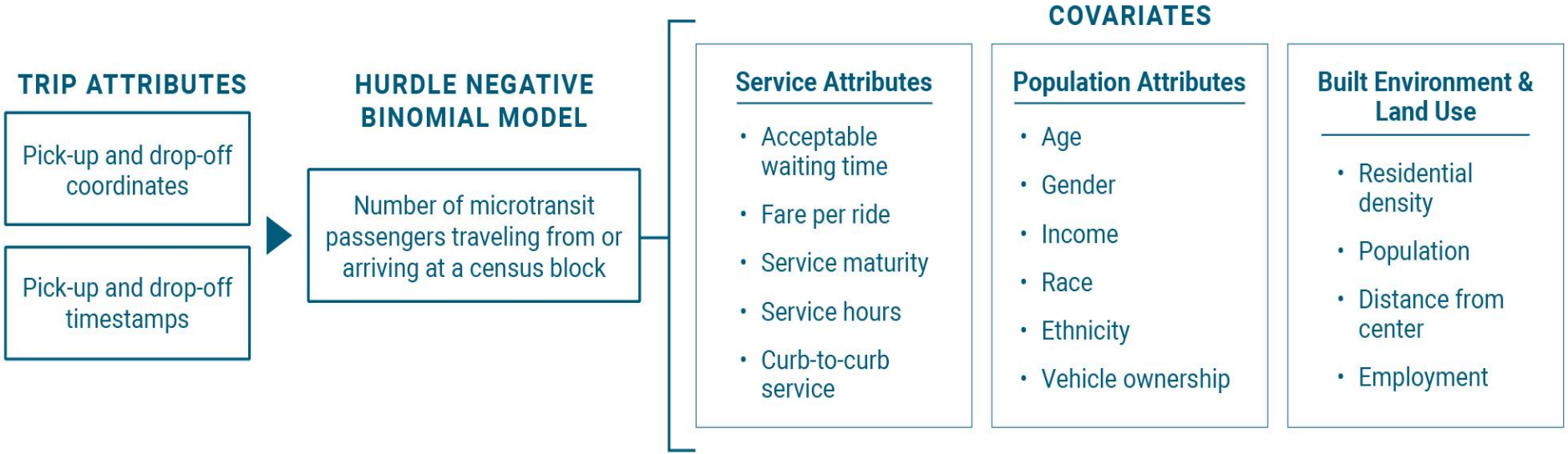
Microtransit systems	Wilson, RIDE	Wilmington, RideMICRO	Wake County, GoWake SmartRide NE	Johnston County, QuickRIDE	YVEDDI, GoTransit
Service area population	40,351	125,800	36,894	20,709	6,484
Population density (people/mile²)	1,301	1,238	379	554	378
Zero-vehicle households	12%	5%	2%	13%	8%
Non-White population	59%	16%	39%	40%	17%
Households below poverty	23%	12%	7%	27%	20%
Non-ambulatory population	15%	12%	12%	8%	20%



Characteristics of microtransit systems

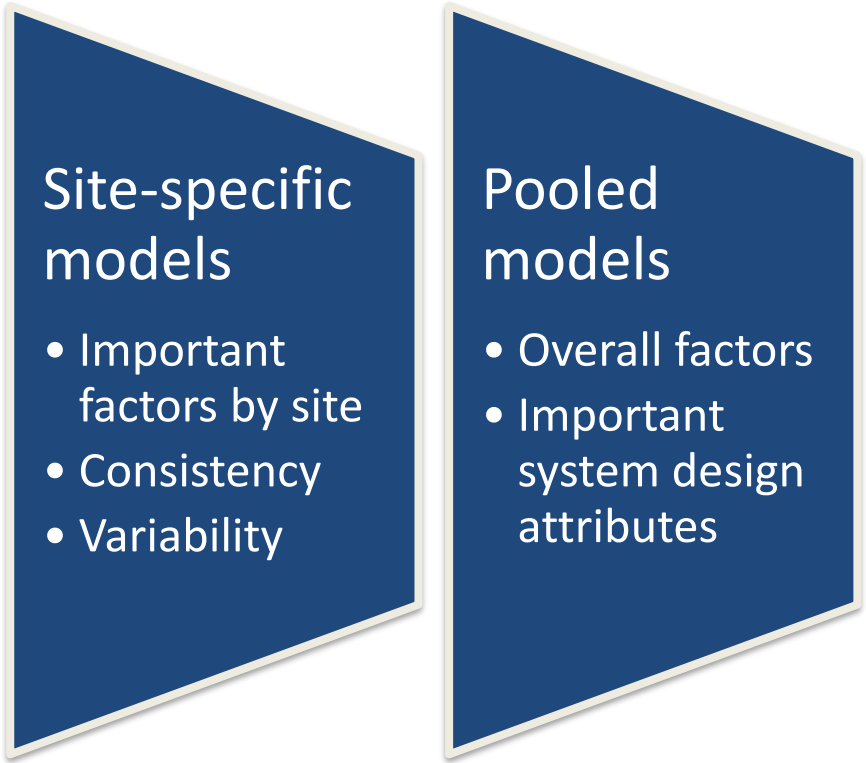
Microtransit system (Start date)	**Wilson, RIDE (2020)**	**Wilmington, RideMICRO (2021)**	**Wake County, GoWake SmartRide NE (2022)**	**Johnston County, QuickRIDE (2023)**	**YVEDDI, Go Transit (2024)**
Systems					
Technology provider	Via	Moovit	EcoLane	CTS	CTS
Fare ($/trip)	$1.50	$2.50	Free	$6.00	$1.00
Prescheduling option	No prescheduling	Up to 7 days in advance	Up to 1 day in advance	No limit on how far ahead the trips can be booked	Up to 1 month in advance
Pick-up policy	Walk to nearby intersections/ destinations	Walk to virtual stops	Curb to curb	Curb to curb	Curb to curb
Acceptable waiting times	15 minutes	60 minutes	30 minutes	15 minutes	15 minutes

Methodological overview



Econometric Analysis: Hurdle NB Models

- **Dependent variable**
  - Number of passenger pick-ups or drop-offs
- **Spatial unit**
  - Census block
- **Temporal unit**
  - Hour in a weekday, summed over a month



Site-Specific Model Results

	Logit component				
Variable	Wilson	Wilmington	Wake County	Johnston County	YVEDDI
Intercept	-3.440 (0.203)***	-7.628(0.156)***	-4.978 (0.265)***	-8.872(0.020)***	-5.927(0.205)***
Population	0.004 (0.000)***	0.003 (0.000)***	0.001 (0.000)**	0.006(0.000)***	0.008 (0.000)***
Residential density	0.101 (0.000)***	-0.474 (0.000)***	0.417 (0.000) ***	0.001(0.000)	0.054(0.037)
Per-capita income	-0.030 (0.001)***	0.006 (0.001)***	-0.017 (0.000)***	-0.012 (0.005)**	-0.013 (0.003)***
% African Americans	0.010(0.000)***	0.007 (0.000)***	0.029 (0.000)***	0.010 (0.001)***	0.022(0.002)***
% Female	0.011 (0.000)***	0.018 (0.002)***	0.006 (0.004)	0.060 (0.003)***	0.016(0.001)***
% Age group 18-44	0.010 (0.000)***	0.017 (0.001)***	0.015 (0.002)***	0.046(0.003)***	0.036 (0.003)***
% Hispanics	0.001 (0.000)***	0.012 (0.000)***	0.007 (0.001)**	-0.003 (0.001)*	0.000 (0.000)
% Zero-vehicle households	0.009 (0.000)***	0.013 (0.000)***	0.004 (0.003)	0.012 (0.002)***	0.064(0.004)***
Low-wage jobs	0.014 (0.000)***	0.009 (0.000)***	0.019 (0.000)***	0.009 (0.000)***	0.024(0.000)***
Health-related jobs	0.007 (0.000)***	0.000 (0.000)	0.025 (0.001)**	0.003 (0.000)***	0.002(0.000)***
Network distance from center	-0.361 (0.005)***	-0.081 (0.013)***	0.008 (0.006)	-0.277 (0.000)**	-0.093 (0.023)***
Late morning (9AM-12PM)	0.638 (0.014)**	-0.119 (0.081)***	0.778 (0.071)**	0.907 (0.052)***	1.482 (0.006)**
Early afternoon (12-4PM)	0.540 (0.002)***	-0.028 (0.002)***	0.760 (0.072)**	0.818 (0.051)***	0.501 (0.006)**
Afternoon/Evening (after 4PM)	-0.258 (0.017)***	-0.146 (0.035)***	0.246 (0.075)**	-0.037(0.053)	0.109(0.008)**
Tract fixed effects	Yes	Yes	Yes	Yes	Yes
Month indicator variables	Yes	Yes	Yes	Yes	Yes
	Count component				
Variable	Wilson	Wilmington	Wake County	Johnston County	YVEDDI
Intercept	-0.815 (0.006)***	-4.814 (0.673)***	-2.736 (0.560)***	- 5.422(0.208)**	-0.984 (0.316)***
Population	0.001 (0.000)***	0.002 (0.000)***	0.002 (0.000)*	0.005 (0.000)	0.001 (0.000)***
Residential density	0.077 (0.001)***	-0.317 (0.041)***	0.294 (0.133)*	0.405 (0.000)***	0.435 (0.096)***
Per-capita income	-0.001 (0.000)***	-0.001 (0.001)	-0.003 (0.004)	-0.008 (0.003)*	0.003(0.000)***
% African Americans	0.002 (0.000)***	0.002 (0.001)	0.006 (0.002)**	0.012 (0.000)**	0.002 (0.005)
% Female	0.006 (0.001)***	0.035 (0.005)***	-0.078 (0.010)***	0.008 (0.006)	0.006(0.000)*
% Age group 18-44	0.012 (0.00)***	0.027 (0.003)***	0.015 (0.010)	0.020 (0.000)**	0.027(0.004)***
% Hispanics	- 0.003 (0.000)***	0.008 (0.005)	-0.011 (0.003)	0.001 (0.002)	-0.012(0.001)***
% Zero-vehicle households	0.016 (0.001)***	0.031 (0.005)***	0.003 (0.000)*	0.019 (0.003)***	0.018(0.006)**
Low-wage jobs	0.020 (0.000)***	0.002 (0.000)***	0.009 (0.002)*	0.007(0.000)***	0.009(0.000)***
Health-related jobs	0.001 (0.000)**	0.002 (0.000)*	0.015 (0.003)***	0.001(0.000)***	0.000 (0.000)
Network distance from center	-0.056 (0.022)***	-0.051 (0.030)	0.222 (0.109)**	0.017(0.014)	0.025(0.016)
Late morning (9AM-12PM)	0.240 (0.016)***	-0.510 (0.102)***	0.169 (0.060)**	-0.300(0.125)	0.603(0.056)***
Early afternoon (12-4PM)	0.100(0.017)***	-0.628 (0.080)***	0.137 (0.106)	-0.087 (0.239)	0.197 (0.065)**
Afternoon/Evening (after 4PM)	-0.205 (0.016)***	-0.424 (0.209)	-0.328 (0.240)	-0.505 (0.146)	-0.452 (0.109)**
Tract fixed effects	Yes	Yes	Yes	Yes	Yes
Month indicator variables	Yes	Yes	Yes	Yes	Yes
Number of observations	386100	714780	104860	158040	118820
AIC	546292	102600	36433	52806	67664
BIC	547475	103438	36844	53394	68426
Log-likelihood (0)	-298849	-54701	-23992	-30002	-38408
Log-likelihood (convergence)	-273037	-51227	-18173	-26344	-33753

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Pooled Model Results

	Pooled model — Origin		Pooled model — Destination	
Variable	Logit component	Count component	Logit component	Count component
Intercept	-2.190 (0.112)***	-0.931 (0.102)***	-1.859 (0.100)***	-1.694 (0.185)***
Population	0.003 (0.000)***	0.001 (0.000)***	0.003 (0.000)***	0.001 (0.000)***
Per-capita income	-0.019 (0.000)***	-0.004 (0.000)***	-0.016 (0.000)***	-0.009 (0.000)***
% African Americans	0.012 (0.000)***	0.001 (0.000)**	0.011 (0.000)***	0.003 (0.000)***
% Female	0.017 (0.000)***	0.009 (0.001)***	0.016 (0.000)***	0.023 (0.001)***
% Age group 18-44	0.008 (0.000)***	0.002 (0.000)***	0.008 (0.000)***	0.005 (0.000)***
% Hispanics	0.003 (0.000)***	-0.005 (0.000)***	0.001 (0.000)***	-0.007 (0.000)***
% Zero-vehicle households	0.009 (0.000)**	0.001 (0.000)**	0.009 (0.000)***	0.005 (0.000)***
Residential density	0.017 (0.006)*	0.072 (0.010)***	0.031 (0.007)***	0.010 (0.000)***
Low-wage jobs	0.010 (0.000)***	0.005 (0.000)***	0.012 (0.000)***	0.008 (0.000)***
Health-related jobs	0.003 (0.000)***	0.001 (0.000)***	0.003 (0.000)***	0.000 (0.000)
Network distance from center	-0.022 (0.004)***	-0.026 (0.001)***	-0.083 (0.002)***	-0.008 (0.006)
Maturity	0.041 (0.001)***	0.012 (0.002)***	0.046 (0.000)***	0.014 (0.001)***
Service hours	0.002 (0.000)***	0.001 (0.000)**	0.004 (0.000)***	0.002 (0.000)**
Acceptable waiting time	-0.047 (0.000)***	-0.007 (0.001)***	-0.052 (0.000)***	-0.009 (0.000)***
Fare per trip	-0.115 (0.000)***	-0.057 (0.004)***	-0.107 (0.007)***	-0.002 (0.010)
Curb to curb	0.903 (0.041)***	0.620 (0.060)***	0.865 (0.041)***	0.488 (0.061)***
Late morning (9AM-12PM)	0.664(0.017)***	0.362 (0.017)***	0.364 (0.010)***	0.074 (0.054)
Early afternoon (12-4PM)	0.622 (0.017)***	0.511 (0.016)***	0.362 (0.018)***	-0.192 (0.020)***
Afternoon/Evening (after 4PM)	-0.244 (0.012)***	-0.289 (0.019)***	0.315 (0.012)***	0.307 (0.017)***
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	1482600		1482600	
AIC	836790		830038	
BIC	837388		830636	
Log likelihood (0)	-449235		-438990	
Log likelihood (Convergence)	-418346		-414970	

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Role of neighborhood socioeconomic attributes

- **Lower income & Carless** households
  - Transit-dependent populations --> Microtransit service is essential 
  - Important to maintain affordability

- **Younger** populations (18-44)
  - Tend to travel more
  - Adapt faster to new technologies 
  - Engagement programs for senior citizens

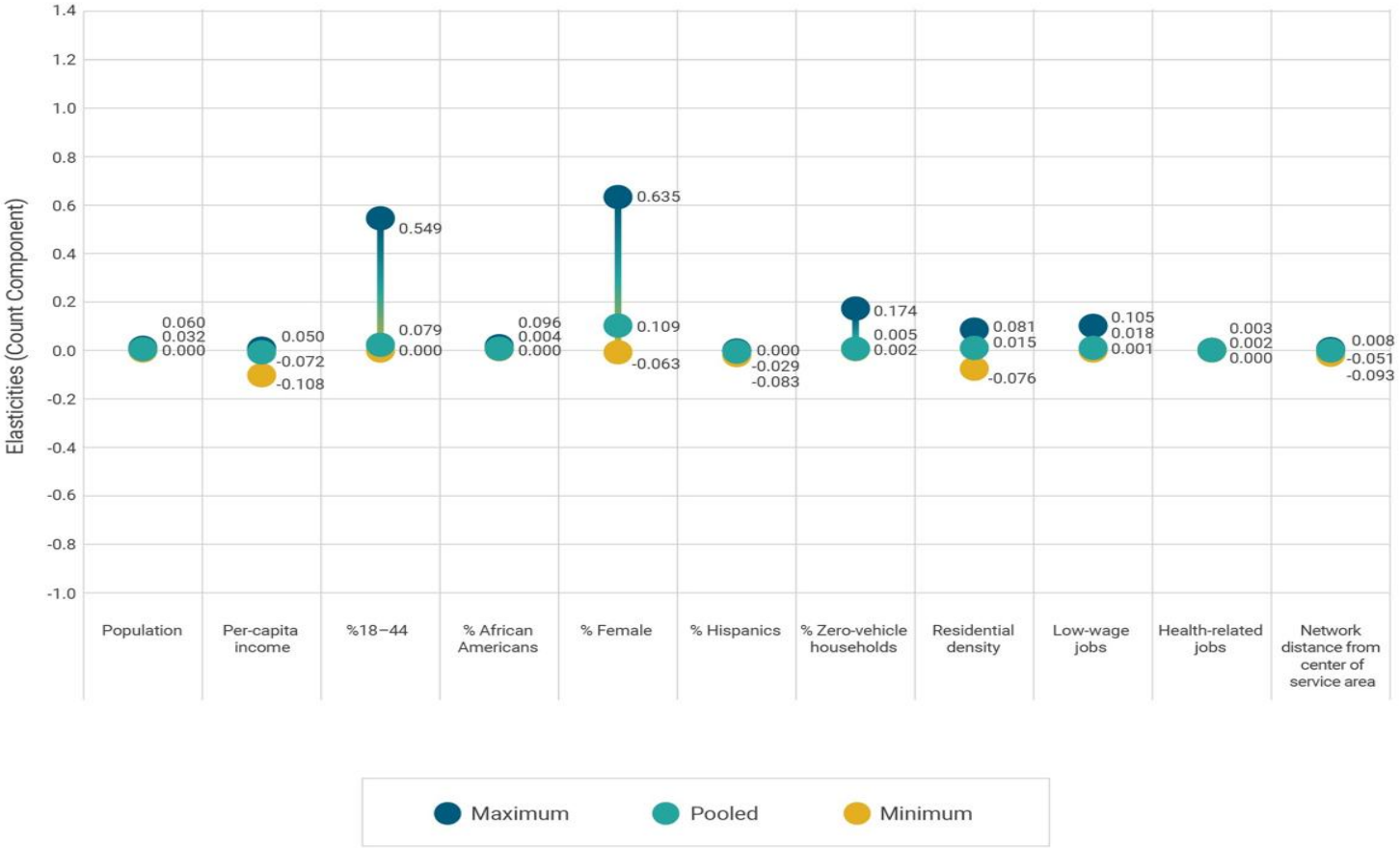
- **Female** populations
  - Less likely to have a driver's license or car access in vehicle-deficit households
  - Consider the needs of the female population

Role of land use and built environment attributes

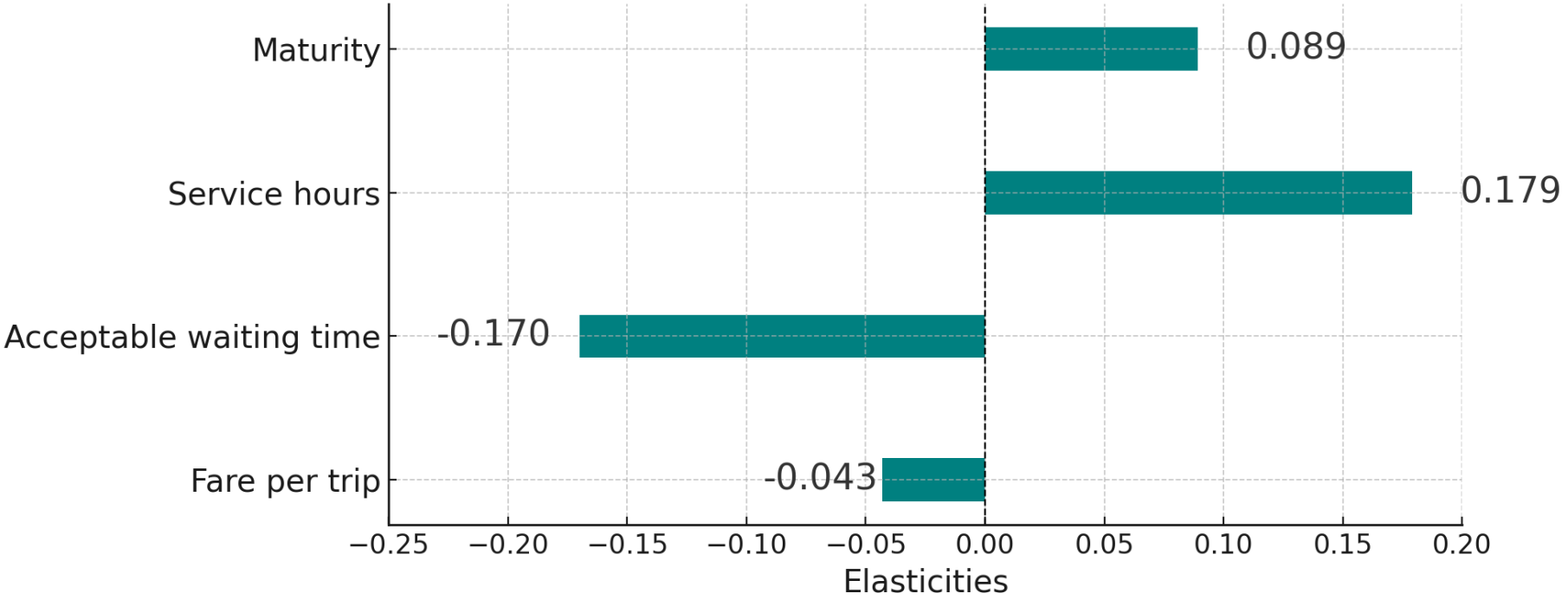
- Low-wage jobs
  - Reflecting **retail and services**
  - **Future partnerships?**
- Health-related jobs
  - Reflecting **medical** land uses
- **Residential** density
  - Exception: Wilmington
- Proximity to population **centers**

Variation in population and land-use factors



- Greater variability
  - Age
  - Female
- Lower magnitude
  - Low-wage jobs
  - Health sector jobs

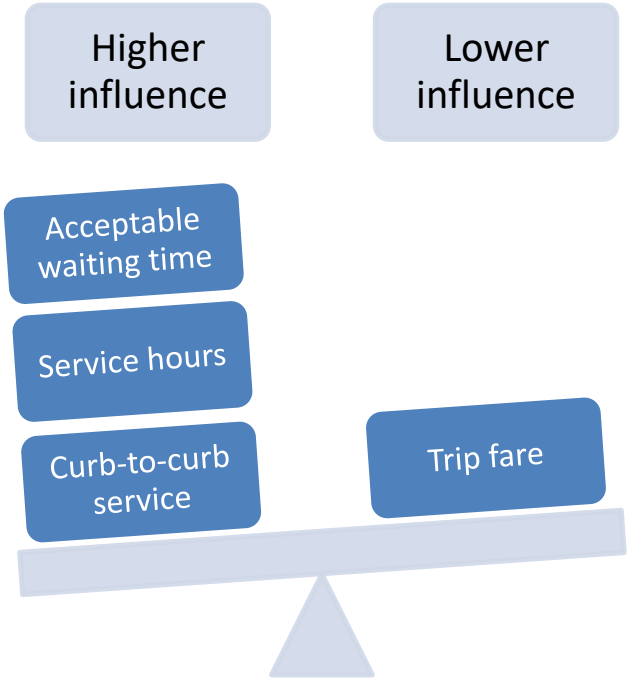
Elasticities of microtransit service design attributes



❖ Curb-to-curb service (semi-elasticity): 84% higher number of passenger pick-ups

Role of service design attributes

- **Walking to pick-up point**
  - Mobility impaired, adverse weather, evening hours, unsafe crossings, safety concerns
- **Service hours**
  - Accommodating a broader range of travel needs: e.g., evening shifts



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Thank you

Questions/Comments?

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