Investigating Value of Time and Value of Reliability for Managed Lanes

Xia Jin, Florida International University

May 6, 2015

Outline

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- Background
- Objectives
- Methodology
- Data
- Findings
- Next steps

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Motivations


- VOT and VOR are key indicators of travel behavior in responding to pricing, ML strategies, and other system improvements.
- Current practices in Florida use link-based time equivalency toll method, and assumes single VOT for all drivers, regardless of trip length, time of day or purpose.
- VOR is not explicitly accounted for in modeling practices.
- This research intends to gain more understanding of toll behavior through the examination of VOT and VOR, and seeks to propose practical approaches in incorporating VOT and VOR into the modeling framework.

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Background -VOT


- *Time is Money*.
- Value of Time (VOT) represents the marginal benefit of time spent in a certain activity, which also depends on the next available alternative.
- Value is not inherent but subjective, individuals may value time differently at different times.
- VOT ($/hour) = ($\frac{\beta_{TT}}{\beta_{Cost}}$) * 60
- In the context of tolling/pricing: value of travel time savings (VTTS), and willingness to pay.
- In other contexts – residential location choice, activity participation allocation

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Background - VOR


- Travel time reliability measures the variability or level of consistency in travel time that users may experience.
- Similarly, Value of Reliability (VOR) can be defined as the marginal substitution between travel cost and travel time reliability improvement.
- Similarly, VOR varies by the circumstance (individual characteristics, trip attribute, the marginal gain from better reliability)
- Two most common measurement for reliability
  - Mean-variance (mean, standard deviation, travel time index, buffer index, etc.)
  - Schedule delay (percentage of on-time performance)

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Objectives

- Gain better understanding of toll behavior through the examination of VOT and VOR and seeks to propose practical approaches in incorporating it into the modeling framework
  - How to define the quantify the measures
  - How to represent user heterogeneity
  - How to derive VOT and VOR curves for incorporation

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Methodology – Mixed Logit


- Two basic assumptions for MNL model
  - Identical and Independently Distributed (IID)
  - Independence from Irrelevant alternatives (IIA)
  - IID and IIA property limit MNL application in managed lanes study
- In order to accommodate taste variations, Mixed Logit models
  - Allow coefficients as a realization of random variables
  - Recognize multiple observations from single decision maker
  - Include inter-alternative correlation error term

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Methodology – User Heterogeneity


- User Heterogeneity
  - Full segmentation
  - Interaction variables
  - Principal component analysis

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Data – Travel Survey


- Revealed and stated preference survey (by FTE)
  - Survey Period: 11/16/2011 – 12/15/2011
  - Observations:
    - 2,041 respondents
    - 16,327 SP observations (8 different scenarios)
    - 513 RP observations (eligible I-95 respondents)
  - Study Corridors:
    - I-95 between Golden Glades & SR 112
    - I-75 between I-595 and SR 826
    - SR 826 between SR 836 and I-95

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Data – Travel Survey (cont'd)


- Sample Composition

Corridor	Number	Percentage
I-95	1060	52%
I-75	521	25.5%
SR 826	460	22.5%
Total	2041	100%

- Stated Preference Choice alternatives
  - General purpose lane
  - Managed lane
  - Managed lane before the peak period
  - Managed lane after the peak period
  - Managed lane with additional passengers

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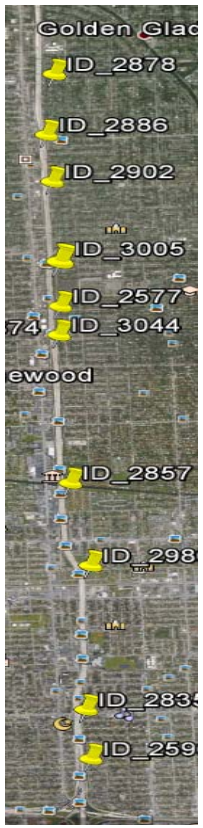
Data – Travel Time


- Regional Integrated Transportation Information Systems (RITIS)
  - Archived detector data from major freeways by direction for general purpose and express lanes
  - Four sets of data were retrieved
  - Two reliability measures were calculated by hour
    - Standard Deviation
    - Travel Time Index

I95SBGPL

I95SBEL

I95NBGPL



I95NBEL

http://www.cattlab.umd.edu/?portfolio=ritis

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Data – Key Variables


- **Choice Attributes**: travel time, travel time reliability, travel cost

- **Trip Attributes**: trip purpose, time of travel, day of the week, trip length, vehicle occupancy, arrival flexibility, travel distance, previous congestion experience, transponder ownership

- **Traveler Characteristics**: gender, age, employment Status, household size, number of household vehicles, annual household income

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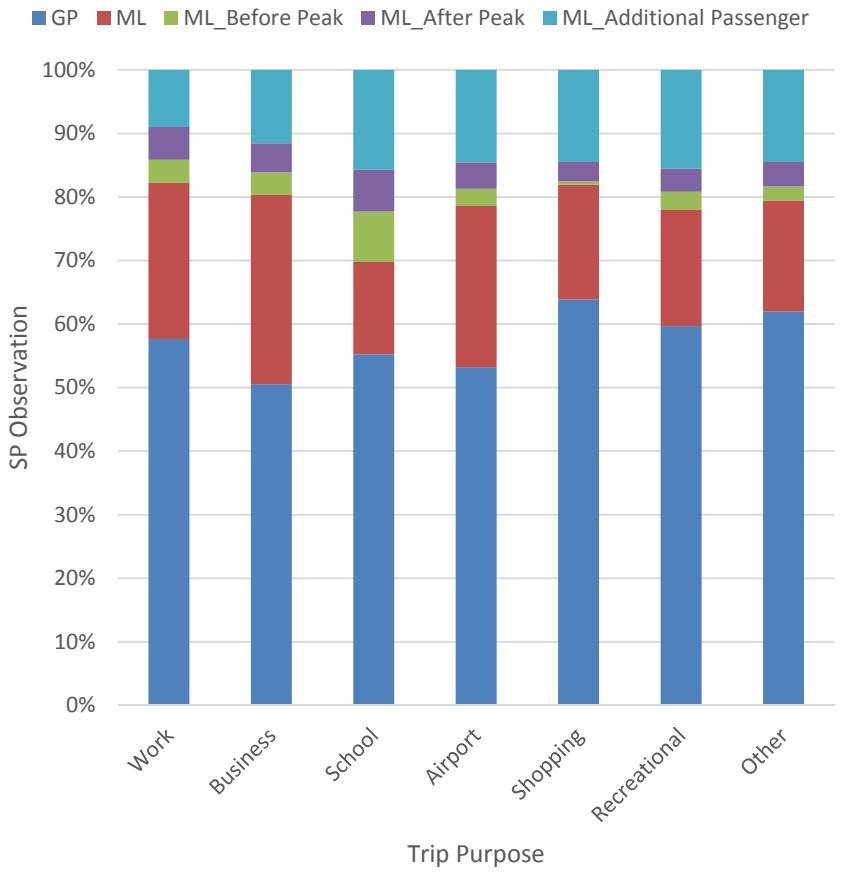
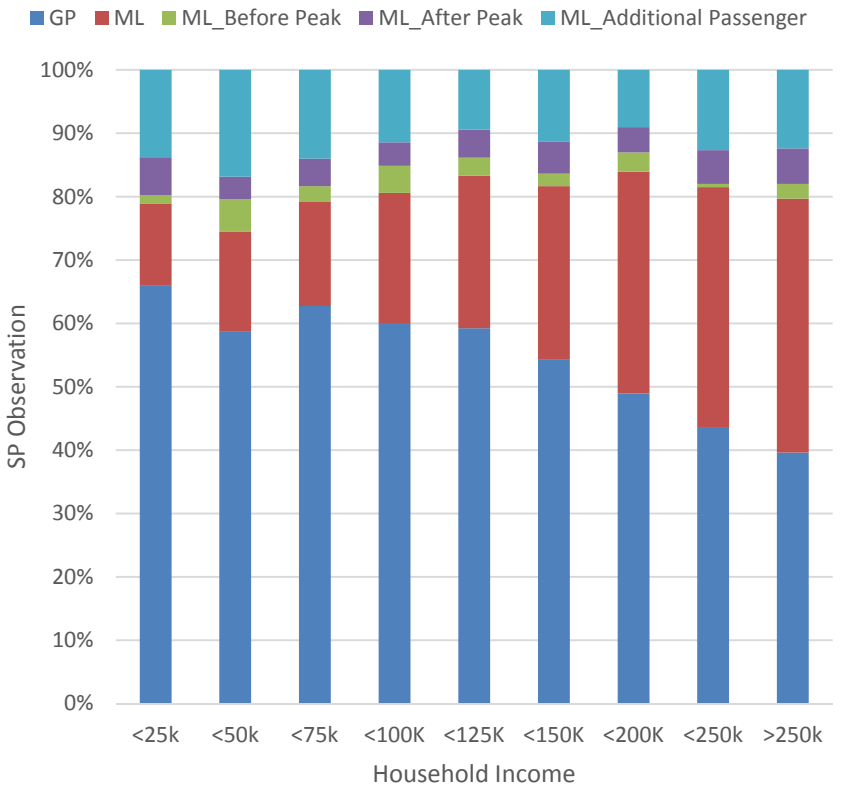
Data - Statistics

Choice Preference by Trip Purpose



Choice Preference by Household Income



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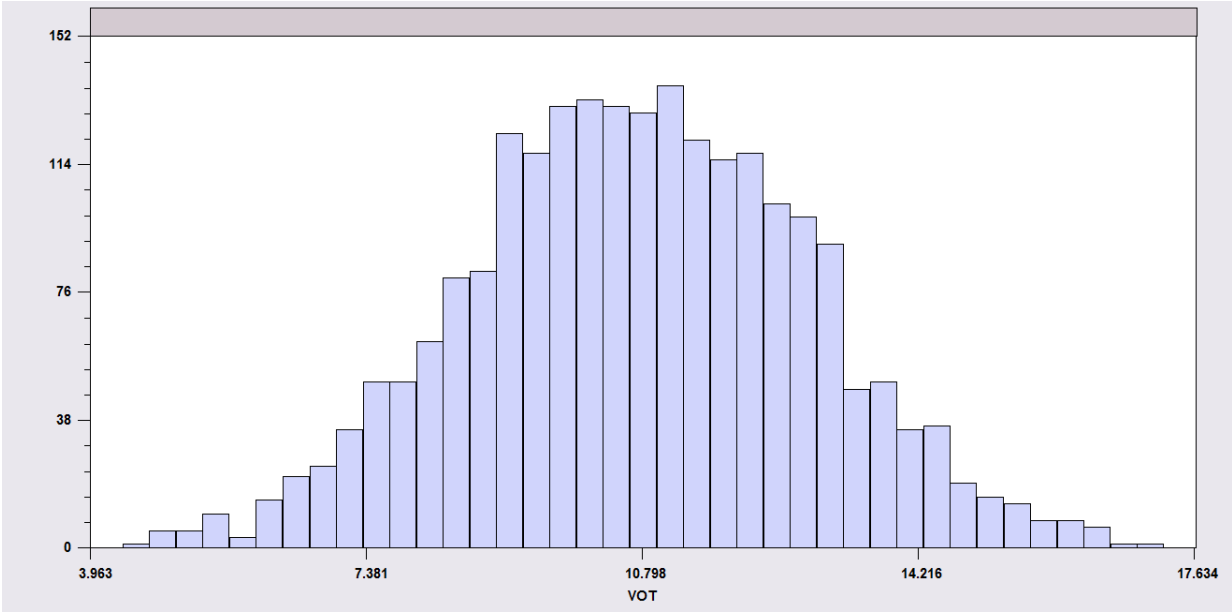
Model Results – VOT and VOR


Parameter	coefficient	t-test	Standard Deviation	t-test
Travel time	-0.106	-12.68	0.02224	5.21
Travel time reliability	-0.46833	-7.35	0.70924	5.64
Travel Cost	-.09461	-13.20		

VOT ($/hour) = ($\frac{\beta_{TT}}{\beta_{Cost}}$) * 60

VOR ($/hour) = ($\frac{\beta_{TTR}}{\beta_{Cost}}$) * 60



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Model Result - Segmentation


Category	VOT (MNL)	VOR (MNL)	VOT (ML)	VOR (ML)
Aggregate	9.30	27.55	10.71	47.33
Low Income (<75K)	9.56	19.53	10.02	37.59
Mid-Income (75K~150K)	8.73	30.11	9.15	42.36
High Income (>150K)	12.81	44.65	15.81	149.51
Age (16~35)	10.10	12.00	10.26	13.41
Age (36~55)	8.34	35.76	9.78	107.45
Age (56+)	12.28	46.07	12.42	63.99
Delay Experienced	9.25	47.85	9.78	50.32
No Delay Experience	12.70	16.34	12.26	116.06

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Model Results - Segmentation


Category	VOT (MNL)	VOR (MNL)	VOT (ML)	VOR (ML)
Aggregate	9.30	27.55	10.71	47.33
Short Trip (<20 mile)	7.88	16.70	10.18	29.18
Medium Trip (20~60 mile)	10.28	44.48	11.50	146.70
Long Trip (>60 mile)	6.90	30.96	6.92	31.30
Work/School, Airport Trips	10.25	131.61	10.68	156.82
Discretionary Trips	7.78	44.48	7.88	65.07
AM Peak	8.75	29.72	12.27	133.20
Off Peak	10.19	39.93	10.44	74.71
PM Peak	8.07	28.48	10.04	30.28
Urgent Trip	6.81	42.20	7.29	62.70
Non-Urgent Trip	11.40	26.73	12.37	48.93
Weekday Trip	10.50	41.80	11.62	100.62
Weekend Trip	5.79	4.89	5.90	22.56

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Model Results – Interaction Effects


	Heterogeneity in mean	Coefficient	t-test	Sensitivity
Travel Time	High Occupancy Vehicle 3+	-0.02149	-3.38	High
	Short Trip	0.01787	3.66	Low
	Medium Income	0.00721	1.75	Low
	High Income	-0.01281	-2.46	High
	Essential Trip	0.00568	2.56	Low
	Age 56-75+	0.00475	2.25	Low
	Male	0.00350	1.77	Low
	Drive with Another Person	0.03103	4.80	Low
Travel Time Reliability	High Occupancy Vehicle 3+	0.24758	2.44	Low
	Short Trip	0.24252	3.47	Low
	Essential Trip	-0.14525	-2.10	High
	Delay Experience	-0.25384	-3.89	High
	Age 56-75+	-0.12306	-1.82	High
	Urgency	-0.17060	-2.43	High
	Male	-0.11970	-1.87	High
	Drive with Another Person	0.`6204	2.03	Low

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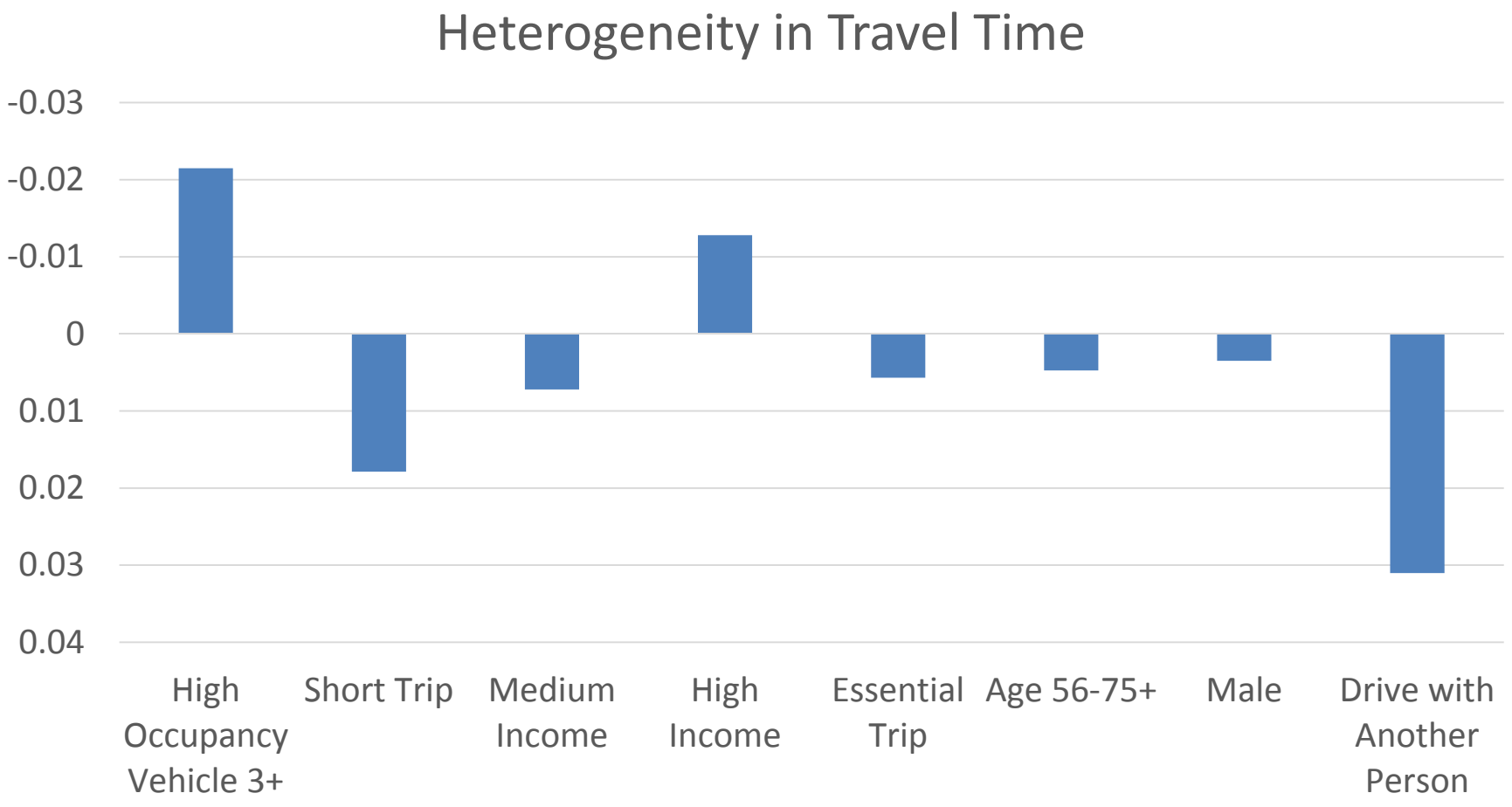
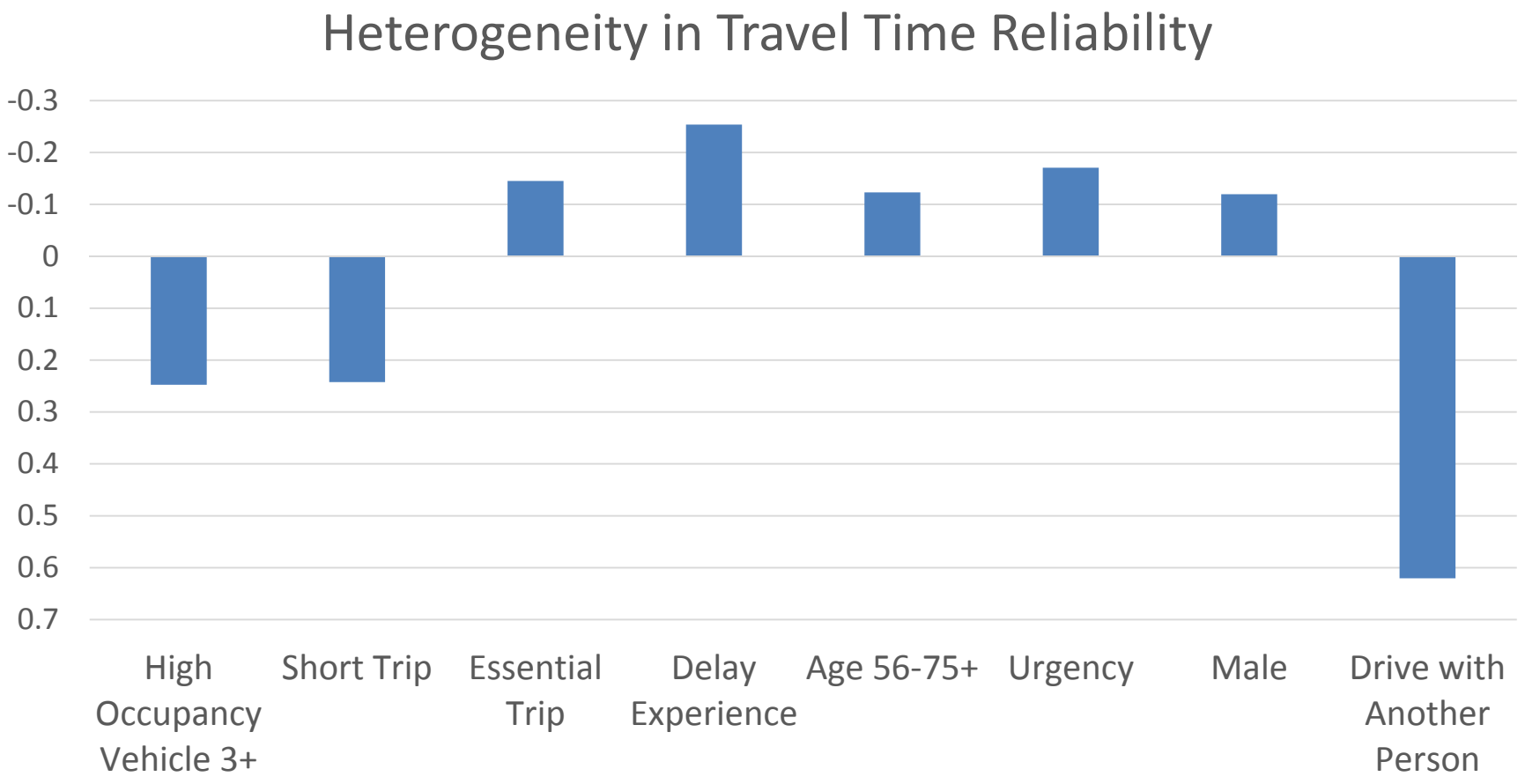
Model Results – Interaction Effects

Model Results – Interaction Effects

Principal Component Analysis


- Initial PCA exploration identified five factors
  - Morning commute (AM peak, frequent, drive alone, time constrained, etc.)
  - Solo traveler (single member household, low auto ownership)
  - Two person households
  - Low income young travelers
  - Local trips

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Findings

- Model results exhibit reasonable VOT and VOR values, which are within the ranges in the literature.
- Mixed logit models shows better performance than MNL in general, and tend to indicate higher average VOT and VOR values.
- Market segmentation exploration indicates the taste variation among users.

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Next Steps


- Refine model specifications
- Further exploration on user heterogeneity
  - Principal component analysis
  - Attitudinal aspects
- Potentials for incorporation into the modeling practices

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Acknowledgement


Diana Fields — Florida Turnpike

Vladimir Majano — Andrew Velasquez URS

Thomas Hill — Mark Fowler RSG

Questions?

Xia Jin, PhD., AICP
Department of Civil and Environmental Engineering
Florida International University
Tel: (305)348-2825 E-mail: xjin1@fiu.edu

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Florida is experiencing a rapid increase in freight activities, with the projected growth in GDP from $720 billion in 2009 to $950 billion in 2020 and over $2 trillion in 2060 [FL Chamber].

In an effort to support the investment and policy decisions that reflect the needs of freight stakeholders in Florida, the Lehman Center for Transportation Research (LCTR) at the Florida International University (FIU) is working with the Florida Department of Transportation (FDOT) in conducting a **stated preference survey** to better understand:

- The underlying factors in freight transportation decisions in terms of system performance attributes,
- Users willingness to pay for improved travel time reliability.

For more information about the survey or the methodology, please do not hesitate to contact us.

Contact Information:

Xia Jin, Ph.D., AICP
Assistant Professor
305-348-2825
xjin1@fiu.edu

Kollol Shams
PhD Candidate
786-308-5942
ksham004@fiu.edu

Florida International University

FLORIDA FREIGHT SURVEY

MOVING FORWARD

YOU CAN HELP SHAPE THE FUTURE OF TRANSPORTATION IN FLORIDA

We are looking for **Shippers, Carriers, Third party logistic providers** or **others** from any region involved in the shipment of raw or finished products by highway, rail, waterways, or air.

Your response to this survey is crucial in achieving the goal of this study to provide the insights to support freight transportation planning and decision-making.

Participation in the survey is simple:

1. Complete the questionnaire about your firm and typical shipment information, which takes about 15 minutes.
2. A unique survey link will be sent to you. The survey will ask about your preferences in various transportation choice scenarios, which takes about 15 minutes to complete.

Your participation in the survey is completely voluntary and your responses will be kept confidential.

Follow the link to participate
https://fiu.qualtrics.com/SE/?SID=SV_eE9dYDjYqWOJtR3
or https://goo.gl/1LDKBE