PLANNING FOR NEW FARE PAYMENT SYSTEMS: AN EQUITY ANALYSIS OF SMARTPHONE, CREDIT CARD AND POTENTIAL MOBILE TICKETING ADOPTION BY BUS RIDERS IN NASSAU COUNTY

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Objective & Methodology

- **Objective:** Assess socioeconomic trends of bus riders who are interested in using a mobile ticketing app
- **Data:** Two surveys of NICE bus riders conducted before mobile ticketing became available:
  - **Survey 1:** System-wide, paper onboard survey
  - **Survey 2:** Smaller, targeted web-based survey specifically about mobile ticketing
- **Methodology:** Cross-tabs and discrete choice models

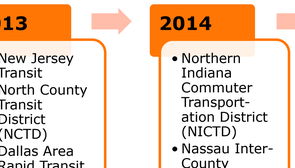

Image Source: http://www.rigsofrods.com/threads/100227-2012-OriOn-VII-CNG-NICE-Bus

How does Mobile Ticketing work?

Select Fare Type → Purchase Ticket → Display Active Ticket

System-wide Survey: Binary Logit

- **Choice Model:** Binary logit model for smartphone adoption estimated with open source software R.[2]
- **Results:** The following groups are more likely to have smartphones:
  - Males
  - Younger riders
  - Students
  - Minority ethnicities
  - Higher incomes

	Smartphone Adoption Independent Variable	Coefficient	(Standard Error)
	Alternative Specific Constant	0.97***	(0.14)
Annual Household Income	Less than $25,000		(reference)
	$25,000 to $49,999	0.35***	-0.08
	$50,000 to $74,999	0.30***	(0.11)
	$75,000 or more	0.66***	(0.14)
Ethnicity	White		(reference)
	Hispanic/Latino	0.39***	(0.11)
	Black/African American	0.55***	(0.10)
	All Other (including multiple)	0.29**	(0.12)
Gender	Female		(reference)
	Male	0.32***	(0.07)
Age	Age 24 and under		(reference)
	Age 25-44	-0.53***	(0.10)
	Age 45 and over	-1.66***	(0.10)
Employ-ment Status	Full-time		(reference)
	Part-time	-0.09	(0.08)
	Retired	-0.31*	(0.17)
	Not employed	-0.62***	(0.10)
Student	Not a student		(reference)
	Student (full or part-time)	0.50***	(0.09)
Summary Statistics	AIC	5635.84	
	BIC	5728.02	
	Log Likelihood	-2803.92	
	Deviance	5607.84	
	McFadden's Pseudo R^2	0.4432	
	Number of Observations	5345	

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Background: Ticketing at NICE

Image Source: Wikipedia

Image Source: NICE Bus website

- Prior to mobile ticketing, riders could pay with:
  - Cash (exact change)
  - New York City MTA's MetroCard[1]
- Fare media were solely issued by the MTA
- Base cash fare ($2.50/ride); several MetroCard options
- Mobile ticketing app launched in 2014, which includes:
  - Pay-per-ride tickets
  - Bundles

System-wide Survey Results: Smartphones

Prior to mobile ticketing in 2013, 67% of NICE bus riders had smartphones. Younger riders and students had higher smartphone adoption levels.

Smartphone Adoption by Age

Smartphone Adoption by Students

N = 7,599 (left graph) All percentages rounded to the nearest whole number. N =7,112 (right graph)

Small Survey: Binary Logit Model

- Results of 3 choice models
- **Smartphone Model:** Minority ethnicities and students more likely to have a smartphone
- **Credit Card Model:** Higher income riders and over age 25 more likely to have credit cards
- **Stated Use of Mobile Ticketing Model:** Males and younger riders may be more likely to adopt mobile ticketing

Category	Independent Variable	Model 1: Smartphone	Model 2: Credit/Debit Card	Model 3: Mobile Ticketing
	Alternative Specific Constant	1.97*** (0.46)	1.85*** (0.51)	0.58* (0.30)
Annual House-hold Income	Less than $25,000	(reference)	(reference)	(reference)
	$25,000 to $49,999	0.14 (0.29)	1.08** (0.39)	0.24 (0.20)
	$50,000 to $74,999	0.37 (0.37)	2.46** (1.04)	-0.09 (0.25)
	$75,000 or more	0.60* (0.36)	0.82* (0.49)	0.06 (0.23)
Ethnicity	White	(reference)	(reference)	(reference)
	Hispanic/Latino	0.71* (0.37)	-0.32 (0.42)	0.16 (0.24)
	Black/African American	0.98** (0.31)	0.36 (0.40)	0.13 (0.20)
	All Other (including multiple)	0.51 (0.31)	0.2 (0.41)	-0.03 (0.21)
Gender	Female	(reference)	(reference)	(reference)
	Male	0.13 (0.22)	-0.23 (0.30)	0.39** (0.15)
Age	Age 24 and under	(reference)	(reference)	(reference)
	Age 25-44	-0.28 (0.39)	0.72** (0.36)	-0.07 (0.22)
	Age 45 and over	-1.59*** (0.39)	1.36*** (0.50)	-0.92*** (0.25)
Employ-ment Status	Full-time	(reference)	(reference)	(reference)
	Part-time	-0.13 (0.33)	-0.07 (0.44)	0.18 (0.22)
	Retired	-0.90* (0.53)	14.11 (880.32)	-0.44 (0.50)
	Not employed	-1.07*** (0.34)	-2.09*** (0.39)	-0.43* (0.25)
Student	Not a student	(reference)	(reference)	(reference)
	Student (full or part-time)	1.09*** (0.39)	0.83** (0.38)	0.40* (0.22)
Summary Statistics	AIC	582.82	373.22	1051.37
	BIC	649.27	439.67	1117.82
	Log Likelihood	-277.41	-172.61	-511.68
	Deviance	554.82	345.22	1023.37
	McFadden's Pseudo R^2	0.2849	0.3146	0.1649
	#of Observations	851	851	851

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$; Standard errors shown in parentheses.

Mobile Ticketing Programs

Many American transit agencies have recently launched mobile ticketing programs.

2012
- New York Waterway
- Massachusetts Bay Transport-ation Authority (MBTA)

2013
- New Jersey Transit
- North County Transit District (NCTD)
- Dallas Area Rapid Transit (DART)
- Tri-County Metropolitan Transport-ation District (TriMet)

2014
- Northern Indiana Commuter Transport-ation District (NICTD)
- Nassau Inter-County Express (NICE) Bus
- The Comet in Columbia
- Capital Metropolitan Transport-ation Authority (CapMetro)

2015
- Virginia Railway Express (VRE)
- San Francisco Municipal Transportation Authority (MUNI)
- Chicago Transit Authority (CTA)
- New Orleans Regional Transit Authority (NORTA)
- Others planned

System-wide Survey Results: Smartphones

Minority ethnicities had higher smartphone adoption levels. NICE riders with higher income levels had higher smartphone adoption levels.

Smartphone Adoption by Ethnicity

Smartphone Adoption by Annual Household Income Level

N = 7,265 (left graph) All percentages rounded to the nearest whole number. N = 6,608 (right graph)

Future Research

- **Actual Mobile Ticketing Use:** Compare survey results with socioeconomic characteristics of actual mobile ticketing users, since the program has launched
- **Bus Operations:** Assess the impact of mobile ticketing on bus dwell times
- **Bus Service Planning:** Use mobile ticketing data for bus service planning (e.g., origin-destination estimation)

References

(1) Nice (Nassau Inter-County Express). http://www.nicebus.com/Home.aspx
(2) R Core Team. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. http://www.R-project.org/.

Acknowledgements

The authors would like to thank Jack Khzouz, Chief of Administration at NICE, for managing the onboard survey process and granting access to the data. Mr. Khzouz also supported the team in developing the web-based survey and provided valuable input.