**Online supplement to**

**“An Investigation of Heterogeneity in Vehicle Ownership and Usage for the Millennial Generation”**

Patrícia S. Lavieri, Venu M. Garikapati, Chandra R. Bhat, and Ram M. Pendyala

**TABLE 1 Descriptive Statistics of the Sample**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Count** | **%** | **Variable** | | **Count** | **%** |
| **Age** |  |  | **Education level** | |  |  |
| 18-20 | 582 | 17.6 | Less than Bachelor’s Degree | | 1715 | 51.8 |
| 21-24 | 889 | 26.9 | Bachelor’s Degree | | 1191 | 36.0 |
| 25-29 | 1526 | 46.1 | Graduate Degree | | 403 | 12.2 |
| 30-33 | 312 | 9.4 | **Employment Status** | |  |  |
| **Gender** |  |  | Employed full-time | | 1933 | 58.4 |
| Male | 1532 | 46.3 | Employed part-time | | 569 | 17.2 |
| Female | 1777 | 53.7 | Student | | 807 | 24.4 |
| **Annual household income** |  |  | **Parent** | |  |  |
| Under $25,000 | 435 | 13.1 | Yes | | 604 | 18.3 |
| $25,000-$49,999 | 921 | 27.8 | No | | 2705 | 81.7 |
| $50,000-$74,999 | 800 | 24.2 | **Marital Status** | |  |  |
| $75,000-$99,999 | 540 | 16.3 | Single | | 2052 | 62.0 |
| $100,000-$149,999 | 378 | 11.4 | Married | | 1218 | 36.8 |
| $150,000 or more | 235 | 7.2 | Divorced | | 39 | 1.2 |
|  |  |  | **City type** | |  |  |
| **Has a smartphone** |  |  | Transit-rich | | 665 | 20.1 |
| Yes | 2958 | 89.4 | Transit Progressive | | 1326 | 40.1 |
| No | 351 | 10.6 | Transit Deficient | | 1318 | 39.8 |
| **Has a valid driver's license** |  |  | **Residential Location** | |  |  |
| Yes | 3040 | 91.9 | Urban | | 1572 | 47.5 |
| No | 269 | 8.1 | Suburban | | 1241 | 37.5 |
| **Personal Vehicle Ownership** |  |  | Small Town | | 331 | 10.0 |
| Yes | 2618 | 79.1 | Rural | | 165 | 5.0 |
| No | 691 | 20.9 | **Residential Tenure Status** | |  |  |
| **Main Commute Mode** |  |  | Home owner | | 1102 | 33.3 |
| Car | 2471 | 74.7 | Rented | | 1506 | 45.5 |
| Transit | 439 | 13.3 | Living with parents | | 701 | 21.2 |
| Non-motorized | 399 | 12.0 |  | |  |  |
| **Car-dependency indicators** | | | | **Disagree** | **Neutral** | **Agree** |
| I need to drive my car to get where I need to go | | | | 11.0% | 20.3% | 68.7% |
| I love the freedom and independence I get from owning one or more cars | | | | 6.0% | 20.6% | 73.4% |
| When making a trip, I prefer to have the flexibility to use a car in case my plans change | | | | 5.1% | 19.6% | 75.3% |

**TABLE 2 Model Goodness-of-Fit and Structural Equation Estimation Results**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Goodness-of-fit** | | | | | | | | | | | |
|  | | | **Car** | | | | **Transit** | | | **Non-motorized** | |
| Real sample shares | | | 75.7% | | | | 13.8% | | | 10.5% | |
| Predicted shares | | | 75.6% | | | | 14.1% | | | 10.3% | |
| Absolute percentage bias | | | 0.13% | | | | 2.17% | | | 1.90% | |
| Probability of correct prediction for each alternative | | | 76.0% | | | | 37.9% | | | 26.0% | |
| Overall probability of correct prediction | | | 64.8% | | | | | | | | |
| **Structural Equation Component** | | | | | | | | | | | |
|  | **Tech-dependency** | | | **Pro-car** | | **Pro-transit** | | | | **Pro-environment** | |
| **Variable** | **Coef** | **(t-stat)** | | **Coef** | **(t-stat)** | **Coef** | | **(t-stat)** | **Coef** | | **(t-stat)** |
| *Education (base: < Bachelor’s degree)* |  |  | |  |  |  | |  |  | |  |
| Bachelor's degree | 2.692 | (2.31) | | 0.253 | (6.14) | -- | | -- | -- | | -- |
| Graduate degree | 2.692 | (2.31) | | 0.253 | (6.14) | 0.116 | | (1.79) | -- | | -- |
| *Age (base: 30-33 years old)* |  |  | |  |  |  | |  |  | |  |
| 18 to 20 years old | -- | -- | | -0.263 | (-3.82) | -0.136 | | (-2.07) | 0.060 | | (1.53) |
| 21 to 24 years old | -- | -- | | -- | -- | -- | | -- | 0.060 | | (1.53) |
| 25 to 29 years old | -- | -- | | -- | -- | -- | | -- | -- | | -- |
| *Male (base: female)* | -- | -- | | -- | -- | 0.222 | | (4.32) | -0.094 | | (-2.31) |
| *Parent (base: no kids)* | -- | -- | | 0.285 | (4.17) | -- | | -- | 0.062 | | (1.52) |
| *White (Base: Asian, Black, Native Am)* | -- | -- | | -- | -- | -0.372 | | (-6.50) | -0.369 | | (-7.29) |
| *Hispanic (base: non-Hispanic)* | -- | -- | | -- | -- | 0.368 | | (5.58) | 0.191 | | (3.26) |
| *City type (base: transit deficient)* |  |  | |  |  |  | |  |  | |  |
| Transit Progressive | -- | -- | | -- | -- | 0.309 | | (5.66) | -- | | -- |
| Transit Rich | 1.015 | (1.83) | | -0.252 | (-6.22) | 0.574 | | (7.77) | -- | | -- |

(--) not statistically significant and therefore removed from the model

**TABLE 3 Impact of Latent Variables on Non-nominal Dependent Variables and Correlations Among Latent Constructs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Impact of Latent Variable on Non-nominal Indicators** | | | | | | |
| **Latent variable** | **Indicators** | **Const** | **(t-stat)** | | **Coef.** | **(t-stat)** |
|  | **Ordinal** |  | |  |  |  |
| Pro-car attitude | I need to drive my car to get where I need to go | 1.531 | | (35.81) | 0.711 | (29.93) |
| I love the freedom and independence I get from owning one or more cars | 2.396 | | (37.06) | 1.165 | (50.16) |
| When making a trip, I prefer to have the flexibility to use a car in case my plans change | 2.159 | | (39.56) | 0.868 | (40.13) |
| Pro-transit | Riding transit is less stressful than driving on congested highways | 1.925 | | (25.35) | 0.872 | (33.50) |
| I feel safe when riding public transportation. | 2.112 | | (29.45) | 0.820 | (21.67) |
| Proximity to public transportation is important when choosing household location | 1.171 | | (21.14) | 0.630 | (22.87) |
| I like the idea of doing something good for the environment when I ride transit | 3.241 | | (29.67) | 0.137 | (2.66) |
| Pro-Environment | I like the idea of doing something good for the environment when I ride transit | 3.241 | | (29.67) | 1.075 | (15.41) |
| If everyone works together, we could improve the environment and future for the earth | 2.838 | | (29.20) | 0.610 | (31.14) |
| I would switch to a different form of transportation if it would improve air quality | 2.954 | | (33.65) | 1.079 | (47.54) |
| Tech-dependency | Importance of having access to ICT throughout the day | 2.237 | | (23.53) | 0.042 | (1.88) |
|  | **Count** |  | |  |  |  |
| Tech-dependency | Number of ICT devices that the individual owns | 1.461 | | (37.94) | 0.114 | (2.47) |
| Number of activities conducted using ICT devices | 0.927 | | (28.38) | 0.094 | (2.34) |
| **Latent variables correlations** | | **Coefficient** | | | **(t-stat)** | |
| Tech-dependency and pro-environment | | 0.354 | | | (2.22) | |
| Pro-car and pro-environment | | 0.382 | | | (9.25) | |
| Pro-transit and pro-environment | | 0.724 | | | (15.90) | |

**TABLE 4 Discrete Choice Estimation Results for Driver’s License Holding and Personal Vehicle Ownership**

|  |  |  |
| --- | --- | --- |
| **Driver's License Holding (base: has a driver’s license)** | **No Driver’s License** | |
| **Variable** | **Coef.** | **(t-stat)** |
| Constant | -3.516 | (-12.99) |
| *Age (base: 21-33 years old)* |  |  |
| 18 to 20 years old | 0.304 | (2.00) |
| *Lives in an urban area (base: suburban, small town or rural area)* | 0.225 | (5.27) |
| *Household tenure status (base: owns residence)* |  |  |
| Rent | 0.944 | (11.26) |
| Lives with parents | 0.944 | (11.26) |
| *Single (base: married or living with significant other)* | 0.296 | (2.40) |
| *Student (base: full-time or part-time worker)* | 0.682 | (10.37) |
| *Latent variables* |  |  |
| Pro-environment | 0.046 | (2.00) |
| Pro-transit | -- | -- |
| Pro-car | -0.627 | (-11.14) |
| Tech-dependency | 0.273 | (4.01) |
| **Personal Vehicle Ownership (base: has a personal vehicle)** | **No Personal Vehicle** | |
| **Variable** | **Coef.** | **(t-stat)** |
| Constant | -3.516 | (-12.99) |
| *Age (base: 25-33 years old and non-parent)* |  |  |
| 18 to 20 years old (non-parent) | 0.676 | (10.29) |
| 21 to 24 years old (non-parent) | 0.415 | (11.06) |
| *Lives in an urban area and is not a parent (base: non-parent, non-urban area)* | 0.264 | (10.86) |
| *Parent 25-33 years old (base: non-parent, non-urban area, non-transit rich city)* | -0.214 | (-2.69) |
| Additional effect of being a parent living in a urban area | 0.246 | (3.43) |
| Additional effect of being a parent living in a transit-rich city | -0.344 | (-3.06) |
| Additional effect of being a young parent (18-24 years old) | 0.171 | (2.43) |
| *Student (base: full-time or part-time worker)* | 0.517 | (19.24) |
| *Household tenure status (base: owns residence)* |  |  |
| Rent | 0.653 | (18.70) |
| Lives with parents | 1.141 | (22.81) |
| *Household income (base: >US$50,000 per year)* |  |  |
| <US$25,000 | 0.531 | (13.22) |
| US$25,000 to 50,000 | 0.196 | (6.89) |
| *No driver's license holding (base: yes)* | 4.152 | (92.67) |
| *Latent variables* |  |  |
| Pro-environment | 1.083 | (11.58) |
| Pro-transit | -- | -- |
| Pro-car | -1.587 | (-9.73) |
| Tech-dependency | -- | -- |

(--) not statistically significant and therefore removed from the model

**TABLE 5 Discrete Choice Estimation Results and Elasticities for Commute Mode Choice**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Commute mode choice (base: car)** | **Transit** | | **Non-motorized** | |
| **Variable** | **Coef.** | **(t-stat)** | **Coef.** | **(t-stat)** |
| Constant | -1.183 | (-6.57) | -1.706 | (-9.66) |
| *Age (base: non-parent 25-33 years old)* |  |  |  |  |
| 18 to 20 years old (non-parent) | -- | -- | 0.569 | (11.44) |
| 21 to 24 years old (non-parent) | -- | -- | 0.383 | (13.79) |
| *Male (base: female)* | -- | -- | 0.220 | (8.06) |
| *Lives in an urban area in a transit progressive or deficient city and is not a parent (base: non-parents, non-urban area in any type of city)* | -- | -- | 0.221 | (8.67) |
| Additional effect of living in an urban area in a transit-rich city | 0.579 | (9.72) | -- | -- |
| *Distance home to work (base: > 5 miles)* |  |  |  |  |
| < 1 mile | 0.112 | (3.76) | 0.893 | (25.97) |
| 1 to 5 miles | 0.112 | (3.76) | 0.467 | (13.37) |
| *Parent 25-33 years old (base: non-parent, non-urban area)* | -0.084 | (-1.80) | -- | -- |
| Additional effect of being a parent living in an urban area | 0.218 | (4.77) | -- | -- |
| Additional effect of being a young parent (18-24 years old) | 0.166 | (3.32) | -- | -- |
| *Employment status (base: full-time)* |  |  |  |  |
| Part-time | -0.104 | (-3.06) | -- | -- |
| Student | 0.496 | (10.07) | 1.065 | (33.53) |
| *Household tenure status (base: owns residence)* |  |  |  |  |
| Rent | -- | -- | -- | -- |
| Lives with parents | -- | -- | -0.638 | (-17.91) |
| *Household income (base: <US$50,000 per year)* |  |  |  |  |
| US$50,000 to 100,000 | -0.103 | (-4.05) | -- | -- |
| US$100,000 to 200,000 | -0.202 | (-5.71) | -- | -- |
| > US$ 200,000 | -0.202 | (-5.71) | -0.245 | (-4.10) |
| *No Driver's license holding (base: yes)* | 1.009 | (-5.64) | 0.466 | (-2.85) |
| *No Personal vehicle ownership(base: yes)* | 0.039 | (-1.94) | 0.572 | (-17.88) |
| *Household has less vehicles than drivers (base: has more)* | 0.715 | (15.96) | 0.638 | (15.84) |
| Additional effect of being a male in a house with less vehicles than drivers | -0.226 | (-4.93) | -0.181 | (-4.10) |
| *Telecommuter (base: non-telecommuter)* | 0.125 | (4.63) | -0.317 | (-11.42) |
| *Receives transit benefits from employer (base: no)* | 0.690 | (17.90) | -- | -- |
| *Latent variables* |  |  |  |  |
| Pro-environment | -- | -- | -- | -- |
| Pro-transit | 0.570 | (8.65) | -- | -- |
| Pro-car | -0.172 | (-1.92) | -0.172 | (-1.92) |
| Tech-dependency | 0.034 | (1.96) | 0.020 | (1.92) |

(--) not statistically significant and therefore removed from the model

**TABLE 6 Pseudo-elasticities for Age, Geographic and Parenting Effects on Driver’s License Holding, Personal Vehicle Ownership and Commute Mode Choice**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Driver’s License** | | **Personal Vehicle** | | **Car Commute** | | **Transit Commute** | | **Non-motorized Commute** | | |
|  | **Coef.** | **(t-stat)** | **Coef.** | **(t-stat)** | **Coef.** | **(t-stat)** | **Coef.** | **(t-stat)** | **Coef.** | **(t-stat)** | |
| ***Age Effects*** | | | | | | | | | | | |
| Age 18 to 20 (base: ≥ 25 years) | -7.3% | (-3.68) | -14.1% | (-8.09) | -6.8% | (-3.57) | -10.2% | (-2.33) | 90.8% | | (6.64) |
| Age 21 to 24 (base: ≥ 25 years) | -0.5% | (-1.21) | -6.1% | (-7.42) | -4.1% | (-3.91) | -3.5% | (-2.08) | 49.5% | | (5.53) |
| Young parent (base: old parent) | -5.9% | (-3.71) | -21.9% | (-6.64) | -15.0% | (-4.55) | -5.8% | (-0.93) | 169.6% | | (7.11) |
| ***Geographic and Land Use Effects*** | | | | | | | | | | | |
| Urban (base: non-urban area) | -1.9% | (-0.86) | -4.2% | (-2.32) | -5.4% | (-4.54) | 18.3% | (5.23) | 19.2% | | (2.47) |
| Transit-rich city (base: transit progressive or deficient cities) | -3.4% | (-4.85) | -2.4% | (-3.52) | -11.5% | (-2.36) | 84.3% | (5.02) | -10.0% | | (-1.54) |
| Transit-rich city and urban (base: transit progressive or deficient cities and urban) | -3.6% | (-4.63) | -2.5% | (-3.53) | -19.5% | (-2.92) | 141.3% | (6.51) | -15.1% | | (-2.32) |
| Urban and transit-rich city (base: non-urban area and transit-rich city) | -2.3% | (-0.85) | -4.4% | (-2.30) | -16.5% | (-4.19) | 68.6% | (7.26) | 7.8% | | (1.02) |
| Parent in urban area (base: parent in non-urban area) | -1.6% | (-0.84) | -6.0% | (-3.34) | -7.7% | (-4.49) | 40.5% | (7.93) | 13.7% | | (1.81) |
| Parent in transit-rich city (base: parent in transit progressive or deficient cities) | -1.2% | (-3.79) | -0.4% | (-1.04) | -3.8% | (-2.10) | 25.8% | (3.72) | -3.7% | | (-1.14) |
| Parent in urban area in a transit-rich city (base: parent in urban area in progressive or deficient cities) | -3.0% | (-4.19) | -0.1% | (-0.07) | -22.7% | (-3.19) | 159.0% | (6.76) | -19.2% | | (-2.98) |
| Parent in urban area in a transit-rich city (base: parent in non-urban area in a transit-rich city) | -1.9% | (-0.85) | -5.8% | (-3.29) | -20.6% | (-4.25) | 94.2% | (6.44) | 1.0% | | (0.12) |
| Parent in urban area in a traditional city (base: parent in non-urban area in transit progressive or deficient cities) | -4.5% | (-2.07) | -4.5% | (-2.36) | -25.3% | (-3.50) | 175.2% | (6.53) | -2.1% | | (-0.19) |
| ***Parenting Effects*** | | | | | | | | | | | |
| Parent (base: non-parent) | 2.8% | (3.08) | 2.8% | (2.29) | -0.3% | (1.24) | 7.2% | (1.24) | -7.0% | | (-2.73) |
| Young parent (base: young non-parent) | 4.1% | (2.83) | 6.5% | (2.71) | 0.6% | (0.46) | 5.2% | (0.81) | -4.9% | | (-2.39) |
| Parent in transit-rich city (base: non-parent in transit-rich city) | 4.9% | (4.35) | 7.4% | (5.55) | 8.8% | (1.86) | -26.2% | (-4.77) | 0.1% | | (0.01) |
| Parent in transit-rich city (base: non-parent in transit progressive or deficient cities ) | 1.5% | (1.64) | 4.5% | (3.68) | -3.9% | (-2.02) | 35.4% | (3.79) | -10.1% | | (-2.65) |