

MIT AgeLab



Generation Matters

**An Integration of Cohort Analysis &
Travel Demand Modeling**

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BIG PICTURE



- **Historic socialization differentiates generations with respect to their current travel behavior.**
- **When estimating a model with a single data set, age is confounded with generation.**



Generation Differences between Boomers & Matures

| | | Baby Boomers | Matures |
|--------------------|-------|--------------|---------|
| Daily Person Trips | Men | 4.6 | 3.9 |
| | Women | 4.9 | 3.0 |

Source: 1995 NPTS

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Causes of Temporal Change in Daily Person Trips Age Profile

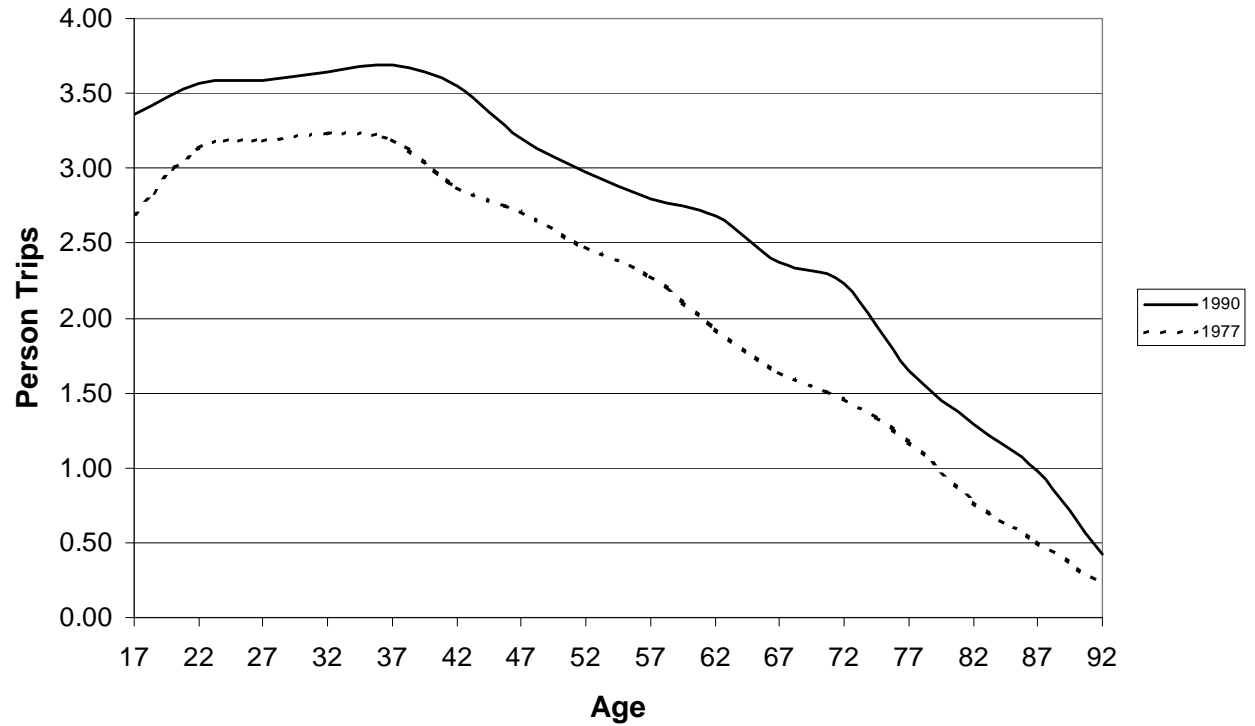
| Effect | Definition |
|--------|--|
| Age | Long-term patterns associated with moving through the life cycle |
| Period | Fluctuations due to circumstances occurring at a particular point in time |
| Cohort | Time-invariant inter-cohort (or generational) differences attributable to common historical experience |

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Daily Person Trips Age Profile



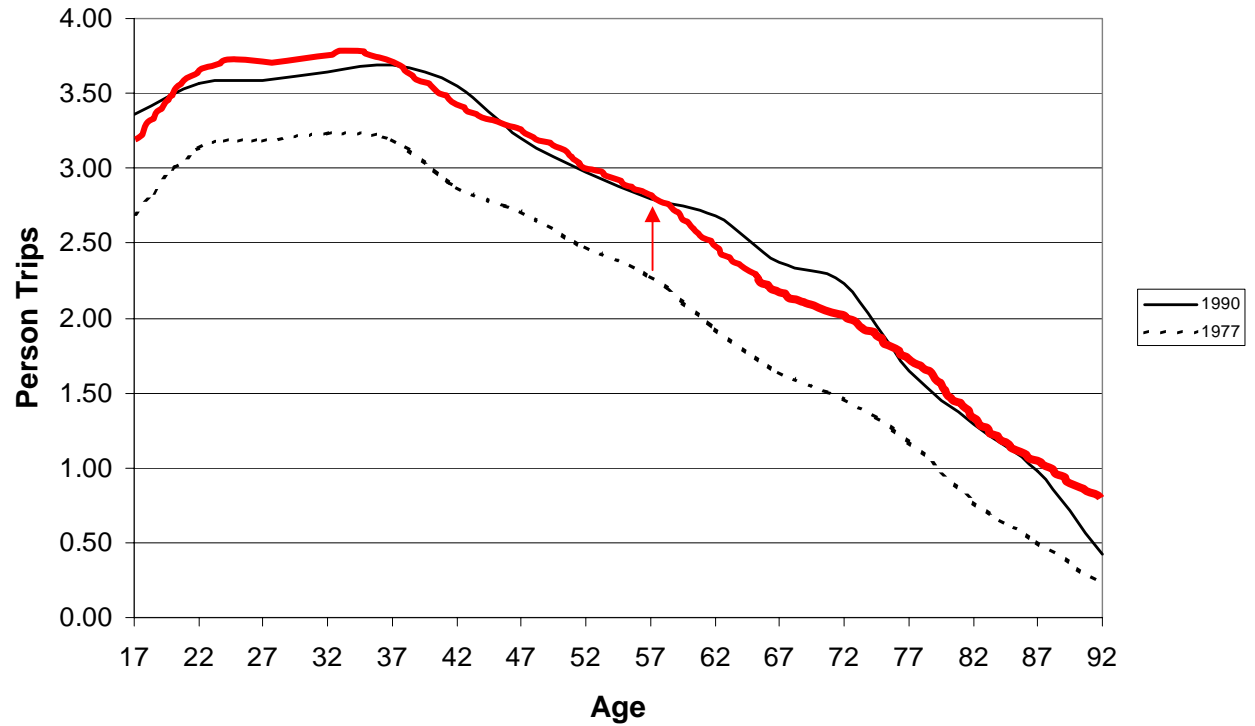
Source: 1990 NPTS; 1977 NPTS

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Daily Person Trips Age Profile



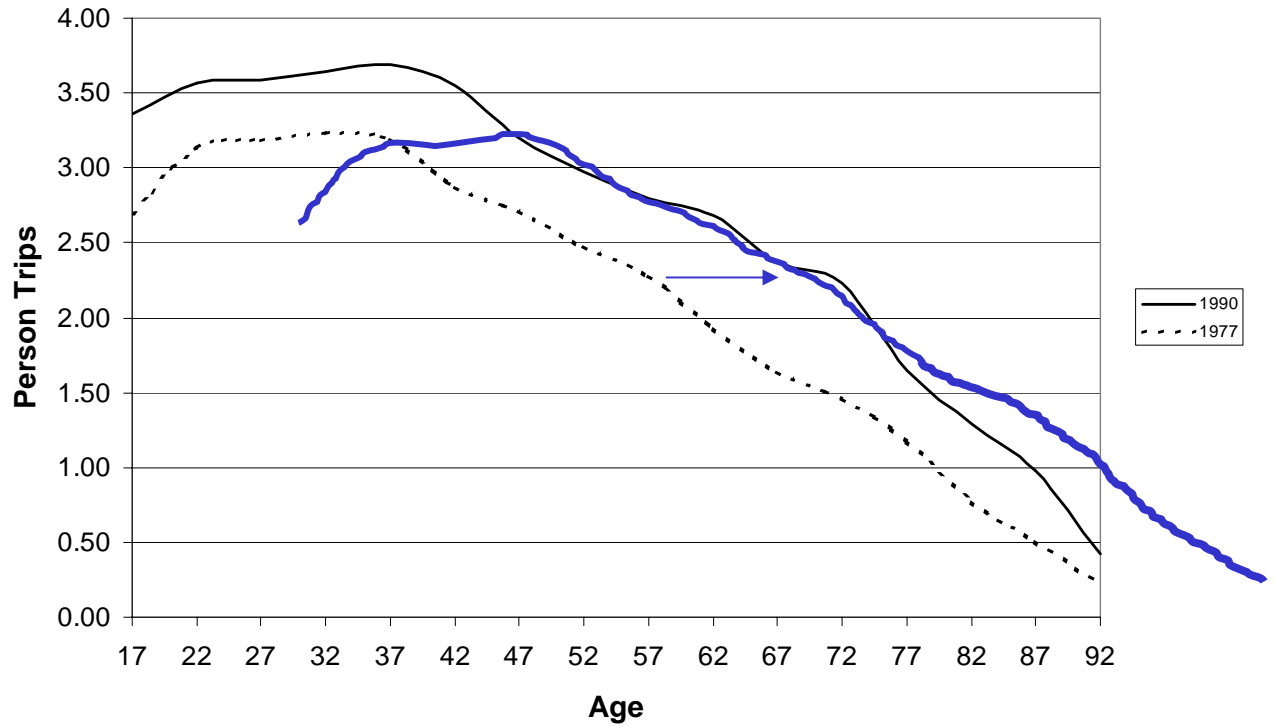
Source: 1990 NPTS; 1977 NPTS

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Daily Person Trips Age Profile



Source: 1990 NPTS; 1977 NPTS

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Linear Dependence between Cohort, Period, and Age Effects

$$C = P - A$$

C = year of birth

P = year of observation

A = age

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Cohort Analysis

| Method | Advantage | Limitation |
|-----------------------------------|---|---|
| Data Exploration | Requires no a priori assumption | Unable to identify age, period, & cohort effects |
| Identification Constraints | Requires a priori restrictions | Biased parameter estimates |
| Theoretical Covariates | Age, period & cohort effects identified | Parameter estimates sensitive to validity of covariates |



Cohort Hypotheses

- **Automobile prevalence during a cohort's late adolescence/early adulthood affects propensity for travel in later stages of the life cycle**
 - **Proxied by per capita U.S. vehicle registration, averaged over the years the individual aged from 15-24 years old**

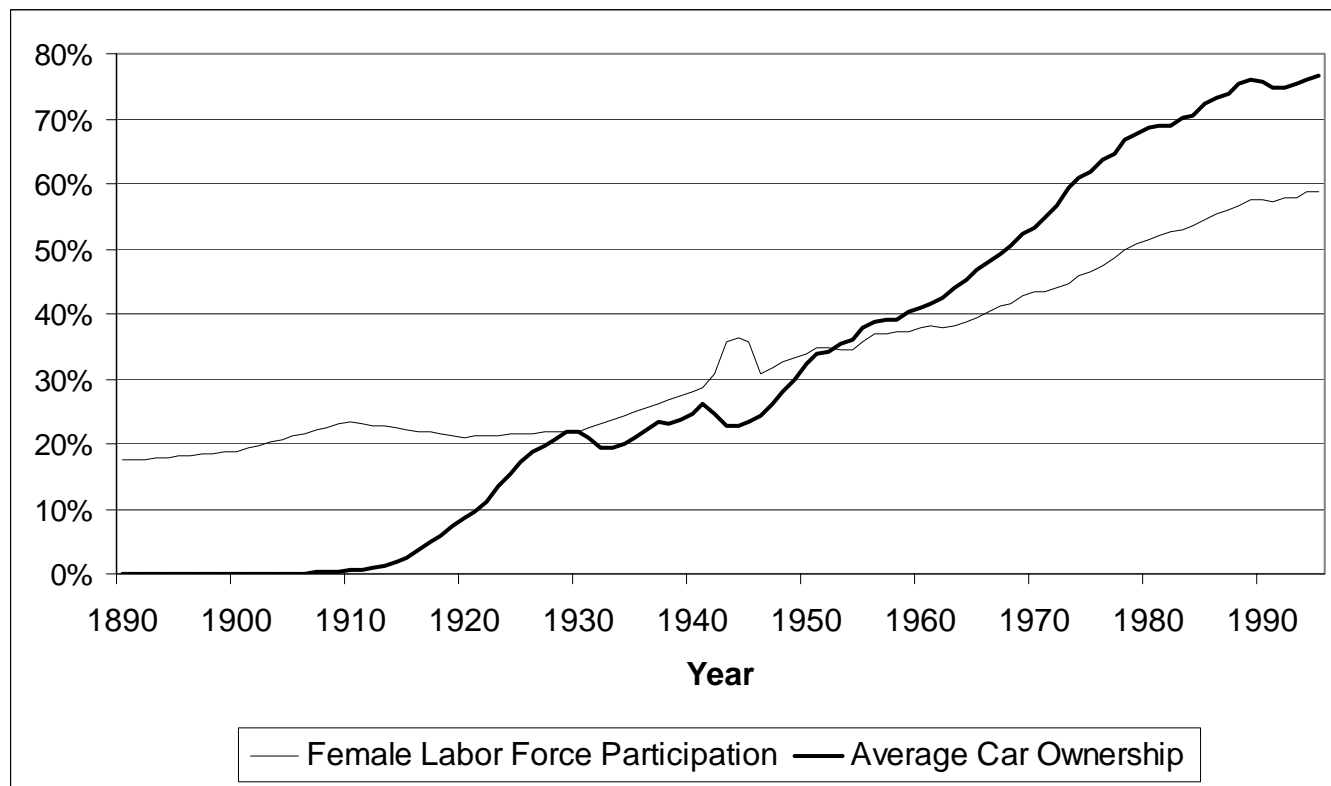
- **Female opportunity for labor force participation during late adolescence/early adulthood affects propensity for female travel at later ages**
 - **Proxied by female labor force participation rate, averaged over the years the individual aged from 15-24 years old, for females (0 for males)**

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Female Labor Force Participation Rates & Average Car Ownership in the U.S., 1890 - 1995



Source: Bureau of the Census (1999). *Statistical Abstract of the United States: 1999* (119th ed.). Washington, DC.; FHWA. (1995). *Highway Statistics: Summary to 1995*. Washington, DC.

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NPTS Data Set Comparison

| | 1977 NPTS | 1983 NPTS | 1990 NPTS | 1995 NPTS |
|---------------------------------|-------------------------------|-------------------------------|--|---------------------------------------|
| Sample Size ¹ | 18,000 | 6,500 | 22,300 | 42,000 |
| Method | Recall; In-home Interview | Recall; In-home Interview | Recall; Computer Aided Telephone Interview | Travel Diary with Telephone Retrieval |
| Conducted By | Bureau of the Census | Bureau of the Census | Research Triangle Institute | Research Triangle Institute |
| Sample Design | Stratified Multistage Cluster | Stratified Multistage Cluster | Stratified Random Digit Dialing | Stratified Random Digit Dialing |
| Response Rate | 85% | 93% | 84% | 55% |

¹ Households

Source: Liss, S. *Effects of Survey Methodology Changes in the NPTS*. Washington, DC: FHWA.
<http://www.cta.ornl.gov/npts/1995/Doc/publications.shtml>

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Estimated Models

Joint Discrete Continuous Models

- Total Number of Sojourns
- Total Person Miles Traveled
- Number of Personal Business Sojourns

Binary Logit Models

- Recreation Sojourning on Travel Day
- Work Sojourning on Travel Day
- Education/Religious Sojourning on Travel Day
- Medical Sojourning on Travel Day
- Trip Chaining on Travel Day
- Transit Usage on Travel Day
- Biking Walking Mode Usage on Travel Day

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Explanatory Variables

Cohort

- Female labor force participation, motorization

Age

- Age (piece-wise linear)

Period

- Period (categorical)

Household Role & Structure

- Household size, children, family, gender, gender-children interaction, race

Capabilities & Commitments

- Per capita income, education, employment status

Mobility & Accessibility

- Vehicle availability, driver-vehicle interaction, urban location, transit proximity

Other

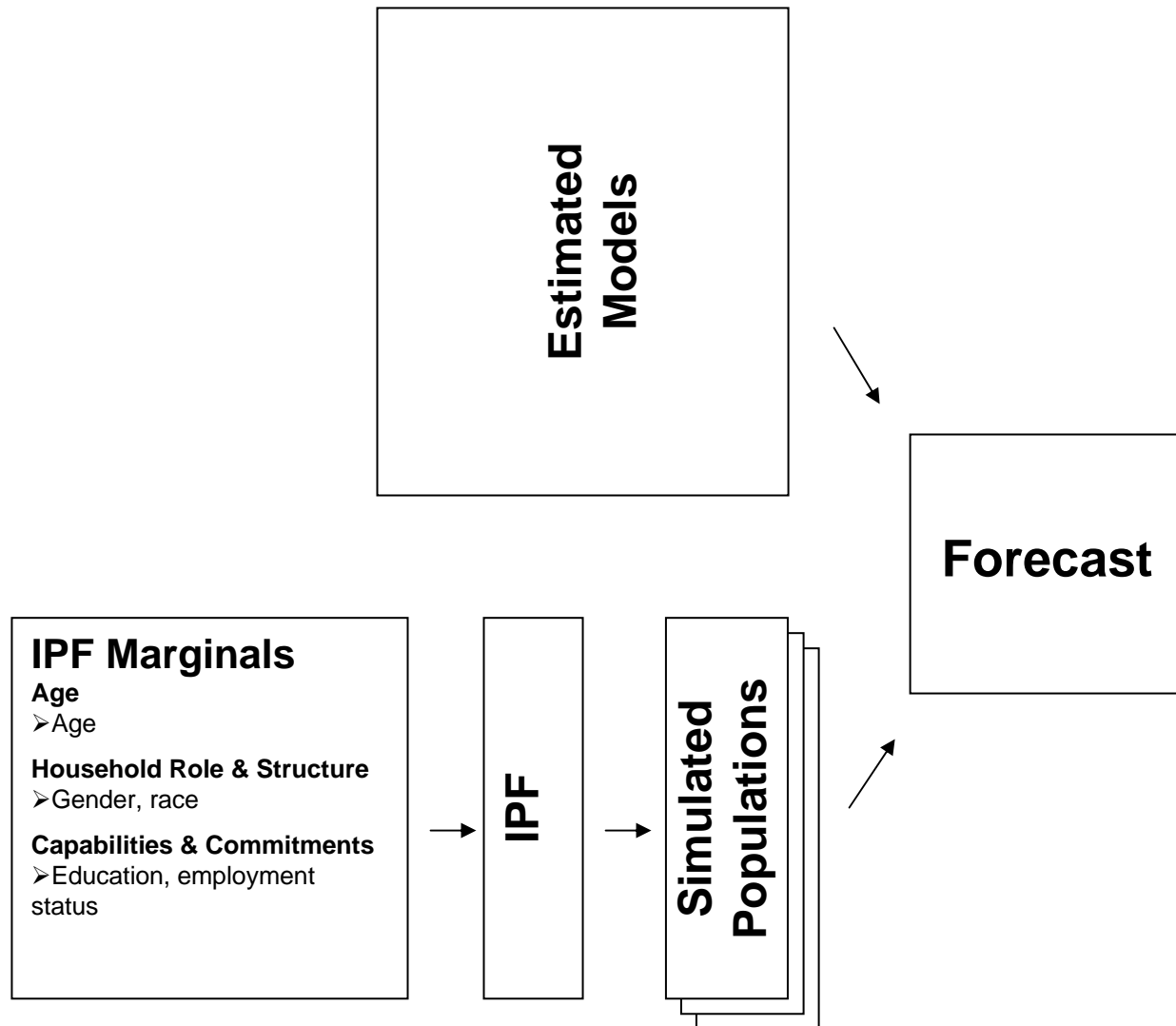
- Weekend travel day, proxy status, correction factor





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RESULTS

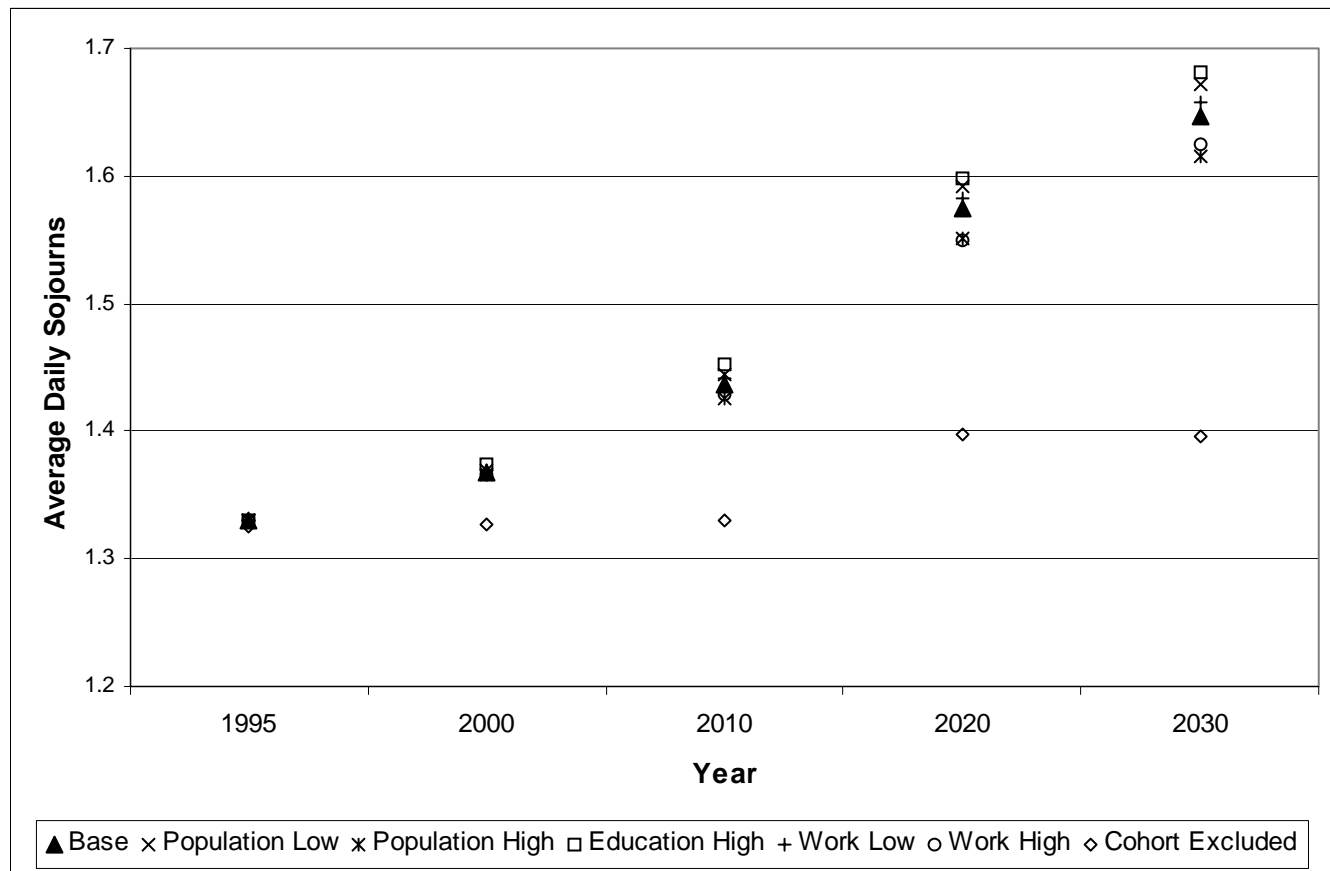
Personal Business Sojourns

| Category | Variable | Discrete Model | | Continuous Model | |
|-------------------------------|----------|----------------|---------|------------------|---------|
| | | Coef. | T-stat. | Coef. | T-stat. |
| Cohort | lnflfp | 0.607 | 12.01 | 1.15 | 13.77 |
| | lnmotor | 0.0721 | 1.49 | 0.203 | 3.03 |
| Age | a25to34 | 0.0112 | 3.18 | 0.0181 | 4.52 |
| | a35to44 | 9.77E-03 | 3.40 | 0.0260 | 7.67 |
| | a45to54 | -9.64E-03 | -3.05 | -0.0184 | -5.08 |
| | a55to64 | 0.0163 | 4.79 | 0.0265 | 6.11 |
| | a65to74 | -1.43E-03 | -0.37 | -8.97E-03 | -2.02 |
| | a75plus | -0.0468 | -9.57 | -0.0929 | -12.22 |
| Period | year83 | 0.250 | 9.56 | 0.639 | 14.81 |
| | year90 | 0.457 | 17.61 | 1.10 | 19.62 |
| | year95 | 1.05 | 35.08 | 2.45 | 22.90 |
| Household | family | 0.0896 | 4.70 | 0.165 | 7.38 |
| Role & Structure | ch0to4 | -0.092 | -4.71 | -0.265 | -11.94 |
| | hh_0to17 | 0.158 | 14.36 | 0.380 | 18.94 |
| | hhsz | -0.102 | -11.75 | -0.195 | -13.31 |
| | black | -0.0695 | -3.11 | -0.0650 | -2.51 |
| | female | 0.678 | 13.18 | 1.32 | 15.04 |
| | fe0to12 | 0.243 | 10.55 | 0.556 | 17.27 |
| Capabilities & Commitments | lnincome | 0.0456 | 4.54 | 0.116 | 8.53 |
| | highed | 0.203 | 11.88 | 0.505 | 16.42 |
| | colled | 0.304 | 13.45 | 0.712 | 17.15 |
| | graded | 0.380 | 15.37 | 0.840 | 17.57 |
| | worker | -0.205 | -13.54 | -0.447 | -17.41 |
| Mobility & Accessibility | vehsatur | -0.0207 | -1.34 | -0.0769 | -4.44 |
| | licveh | 0.723 | 33.73 | 1.54 | 18.52 |
| | urban | 0.0280 | 1.90 | 0.0295 | 1.75 |
| | ptfourth | 0.0712 | 4.57 | 0.125 | 6.38 |
| | ptone | 0.0847 | 4.77 | 0.132 | 6.39 |
| Other | travwknd | -0.174 | -13.58 | -0.491 | -22.25 |
| | proxy | -0.704 | -42.62 | -1.34 | -18.25 |
| | correct | -- | -- | -2.26 | -14.81 |
| | constant | -1.92 | -13.89 | -5.38 | -12.32 |
| Number of observations | | 141,203 | | 72,439 | |
| Rho-squared [R-squared] | | 0.0770 | | 0.0833 | |
| Log likelihood(C) [SST] | | -97827 | | 203082 | |
| Log likelihood(B) [SSE] | | -90296 | | 186169 | |



RESULTS

Forecast of Average Daily 65+ Personal Business Sojourns, by Year



IMPLICATIONS



- **Historic socialization & generation/cohort characteristics impact travel behavior.**
- **Estimation of cohort effects requires comparable data sets from multiple points in time.**
- **Further research opportunities in identifying other cohort indicators and incorporating latent cohort variables.**