

# Travel Time Use over Five Decades

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# Outline

Overview

Related Literature

Demographics Shifts

Aggregate Forces

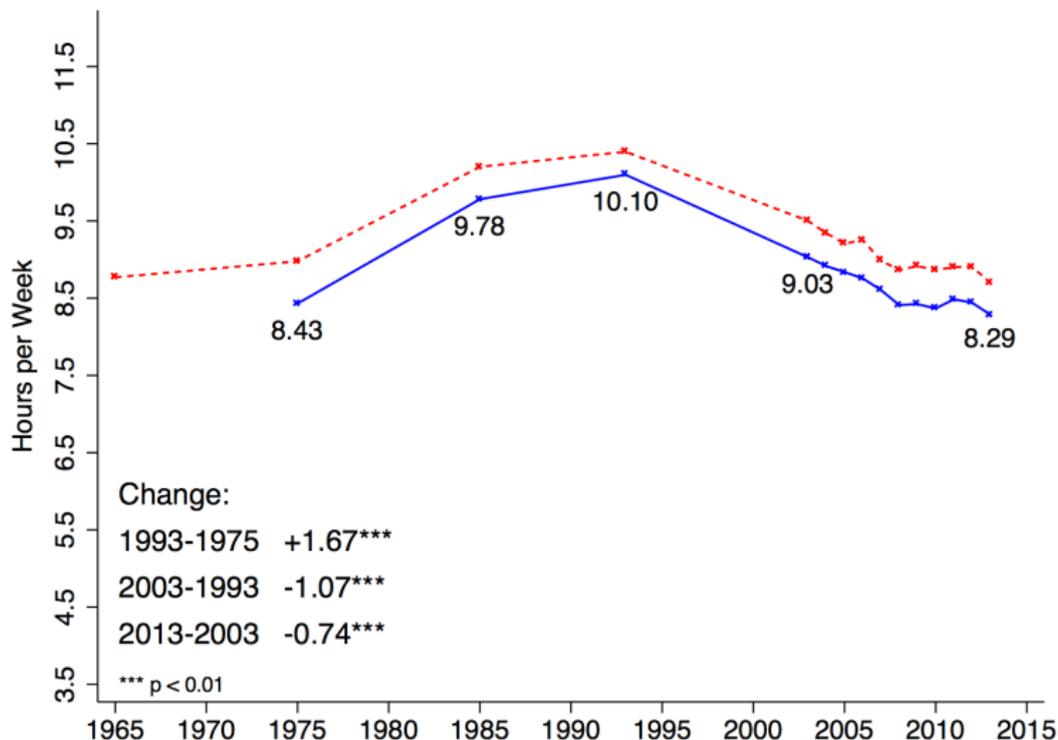
Summary

# Time Use Surveys

- Five major time-use surveys  
1965-1966, 1975-1976, 1985, 1992-1994, 2003-2013 (annual)
- Variables of interest
  - Major time use categories: market work, non-market work and leisure
  - Within each category: travel time and corresponding non-travel time
- Our sample
  - 1975-2013: older than 18
  - 1965-2013: older than 19, younger than 65, not retired
  - Excluding those with missing values for key demographics.

| Dataset | Survey                                   | Total Sample Size | Analysis Sample 1 Size | Analysis Sample 2 Size | Number of Time Use & Travel Categories |
|---------|--|-------------------|------------------------|------------------------|--|
| 1965    | Americans' Use of Time                   | 2,001             |                        | 1,934                  | [95], [9]                              |
| 1975    | Time Use in Economic and Social Accounts | 2,406             | 2,217                  | 1,870                  | [87], [9]                              |
| 1985    | Americans' Use of Time                   | 4,939             | 4,240                  | 3,629                  | [88], [9]                              |
| 1993    | National Human Activity Pattern Survey   | 9,383             | 7,258                  | 6,018                  | [91], [10]                             |
| 2003    | American Time Use Survey                 | 20,720            | 19,759                 | 16,255                 | [435], [58]                            |
| 2004    |  | 13,973            | 13,318                 | 10,889                 | [449], [68]                            |
| 2005    |  | 13,038            | 12,418                 | 10,255                 | [456], [76]                            |
| 2006    |  | 12,943            | 12,200                 | 9,970                  | [456], [76]                            |
| 2007    |  | 12,248            | 11,606                 | 9,477                  | [459], [76]                            |
| 2008    |  | 12,723            | 12,108                 | 9,876                  | [459], [76]                            |
| 2009    |  | 13,133            | 12,568                 | 10,220                 | [459], [76]                            |
| 2010    |  | 13,260            | 12,679                 | 10,277                 | [459], [76]                            |
| 2011    |  | 12,479            | 11,978                 | 9,623                  | [459], [76]                            |
| 2012    |  | 12,443            | 11,975                 | 9,557                  | [459], [76]                            |
| 2013    |  | 11,385            | 10,952                 | 8,626                  | [459], [76]                            |

# Total Variations in Travel Time



# Intriguing Issues

- To what extent do demographic shifts contribute to the evolving patterns of travel time use?
- To what extent can aggregate driving forces common to all demographic groups account for variations in total travel time?
- How travel time co-vary with other time use categories over time across demographic cells?
- What can we say about fluctuations in total travel time, especially the decline after 2003?

# Explaining Travel Time Variations

- Evaluating the Roles of Demographic shifts

Age demographics (baby boomers)

Work-gender groups

Education

Whether there are children in the household

- Changes in time allocation

Economizing on travel

Shift in time allocation

# Main Findings

- Total travel time features an inverted-U shape, registering a 20 percent increase from 1975 to 1993, but an 18 percent decline from 1993 to 2013.
- Demographic shifts explain about 45% of the increase during 1975-1993. Increases in education attainment alone contribute 28%.
- Demographic shifts explain 16% of the decline in travel time during 1993-2003, but play little role since 2003.
- Shift of time allocation from travel-intensive non-market work to travel-non-intensive leisure is a major factor (around 50%) behind the decline since 2003.

# Related Literature

- Time Use Study

Aguiar and Hurst (2007)

Ramey and Francis (2009)

- National Personal/Household Travel Survey

Strong focus on travel

Not linked with broad time use measures

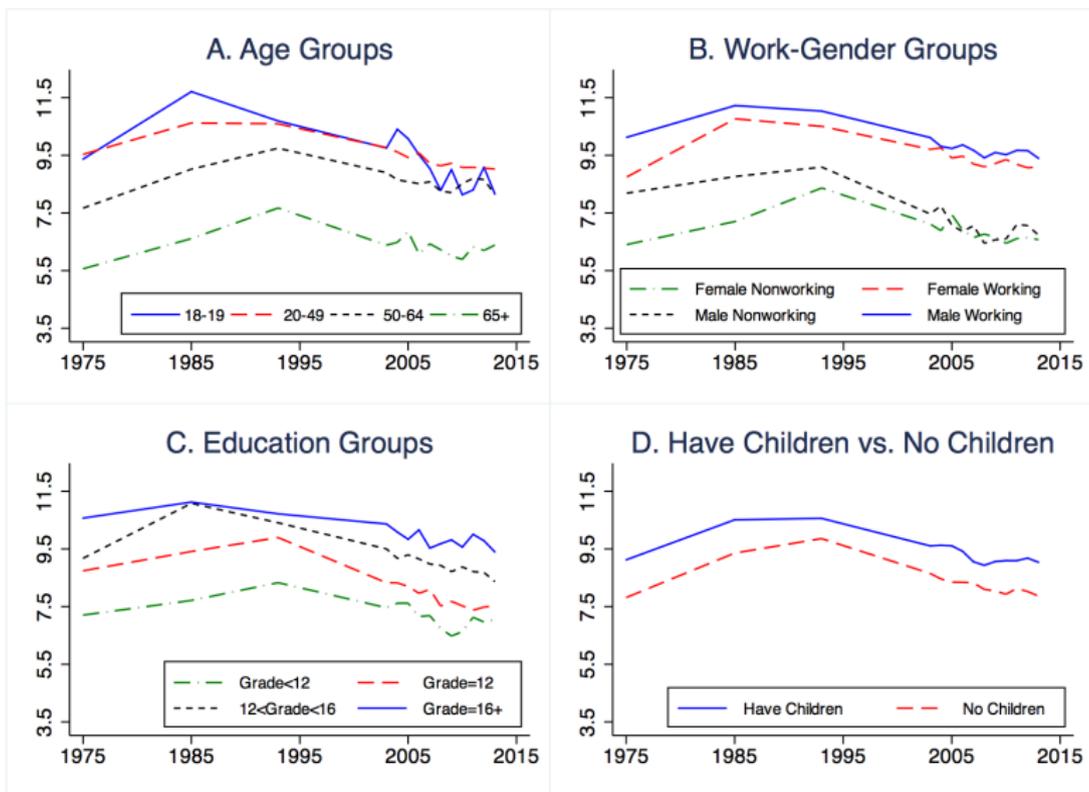
Not linked with data sets such as CPS

Not annual.

# Question I

Can evolving demographics explain changes in travel time?

# Travel Time Patterns by Demographics



## Evolving Weights (in Percentage) of Demographic Groups

|                                | 1975 | 1985 | 1993 | 2003 | 2013 | Average<br>1975-2013 | Difference<br>1993-1975 | Difference<br>2003-1993 | Difference<br>2013-2003 |
|--------------------------------|------|------|------|------|------|----------------------|-------------------------|-------------------------|-------------------------|
| Panel A: By Age Groups         |      |      |      |      |      |                      |                         |                         |                         |
| 18-19                          | 2.7  | 3.4  | 3.0  | 3.4  | 3.2  | 3.1                  | 0.2                     | 0.4                     | -0.2                    |
| 20-49                          | 58.6 | 62.4 | 67.1 | 58.5 | 52.5 | 57.2                 | 8.5                     | -8.5                    | -6.0                    |
| 50-64                          | 20.8 | 20.4 | 18.2 | 22.0 | 26.0 | 23.4                 | -2.5                    | 3.8                     | 4.0                     |
| 65+                            | 17.9 | 13.7 | 11.7 | 16.1 | 18.4 | 16.3                 | -6.2                    | 4.4                     | 2.2                     |
| Panel B: By Work-Gender Groups |      |      |      |      |      |                      |                         |                         |                         |
| Female Nonworker               | 31.0 | 25.0 | 21.1 | 21.3 | 22.3 | 22.1                 | -9.9                    | 0.2                     | 1.0                     |
| Female Worker                  | 21.7 | 30.6 | 33.2 | 30.7 | 29.4 | 30.2                 | 11.5                    | -2.6                    | -1.3                    |
| Male Nonworker                 | 12.5 | 12.1 | 10.1 | 12.2 | 14.8 | 13.00                | -2.4                    | 2.1                     | 2.6                     |
| Male Worker                    | 34.8 | 32.2 | 35.5 | 35.8 | 33.5 | 34.7                 | 0.8                     | 0.3                     | -2.4                    |
| Panel C: By Education Levels   |      |      |      |      |      |                      |                         |                         |                         |
| Grade<12                       | 38.9 | 17.5 | 10.3 | 15.4 | 11.8 | 15.3                 | -28.7                   | 5.1                     | -3.6                    |
| Grade=12                       | 35.6 | 43.2 | 36.1 | 32.5 | 30.3 | 33.1                 | 0.5                     | -3.6                    | -2.2                    |
| Grade:13-15                    | 12.9 | 17.4 | 25.0 | 26.5 | 26.1 | 24.8                 | 12.1                    | 1.5                     | -0.4                    |
| Grade=16+                      | 12.6 | 21.9 | 28.7 | 25.6 | 31.8 | 26.8                 | 16.1                    | -3.0                    | 6.2                     |
| Panel D: By Have Child or Not  |      |      |      |      |      |                      |                         |                         |                         |
| No Child                       | 52.8 | 63.2 | 66.0 | 60.6 | 64.2 | 61.9                 | 13.2                    | -5.4                    | 3.5                     |
| Have Child(ren)                | 47.2 | 36.8 | 34.0 | 39.4 | 35.8 | 38.1                 | -13.2                   | 5.4                     | -3.5                    |

# Quantifying the Role of Demographic Shifts

- Method: Blinder-Oaxaca Decomposition
- Regression equation:  $Y_t = X_t' \beta_t + \varepsilon_t$
- Nine dummy variables:
  - Three age dummies: 20-49, 50-64, above 65;
  - One gender dummy
  - One dummy for work status
  - Three education dummies: high school, some college, college and above
  - One dummy for having children in the household

# Blinder-Oaxaca Decomposition

- $\bar{Y}_{t_1} - \bar{Y}_{t_0} = (\bar{X}_{t_1} - \bar{X}_{t_0})' \hat{\beta}_{t_0} + \bar{X}_{t_1}' (\hat{\beta}_{t_1} - \hat{\beta}_{t_0})$
- Unconditional mean change is decomposed into
  - “Explained”, the portion due to evolving demographic weights, given a fixed set of coefficient estimates and
  - “Unexplained”, the portion due to changes in the relevance of demographics to travel time use and changes in fixed time effects, given fixed demographic weights.
- Reference: starting or ending year, two-year pooled

### Panel A: Results of Two-year Pooled Method

|                    | 1975-1993 | 1993-2003 | 2003-2013 |
|--------------------|-----------|-----------|-----------|
| <b>Difference</b>  | 1.67***   | -1.07***  | -0.74***  |
| <b>Explained</b>   | 0.75***   | -0.18***  | -0.02     |
| -Age               | 0.18***   | -0.10***  | -0.05***  |
| -Work-Gender       | 0.12***   | -0.02     | -0.06***  |
| -Education         | 0.47***   | -0.06***  | 0.11***   |
| -Child             | -0.01     | 0.01      | -0.01*    |
| <b>Unexplained</b> | 0.91**    | -0.89***  | -0.73***  |

| Panel B: Ratio Relative to Difference |           |           |           |
|---------------------------------------|-----------|-----------|-----------|
|                                       | 1975-1993 | 1993-2003 | 2003-2013 |
| <b>Explained</b>                      | 45.2%     | 16%       | 2.2%      |
| -Age                                  | 10.5%     | 8.9%      | 7.6%      |
| -Work-Gender                          | 7.1%      | 1.8%      | 8.2%      |
| -Education                            | 27.9%     | 6.3%      | -15.0%    |
| -Child                                | -0.3%     | -1.0%     | 1.6%      |
| <b>Unexplained</b>                    | 54.8%     | 84%       | 97.8%     |

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## Question II

What are aggregate forces behind common variations in travel time?

# Search for Aggregate Forces

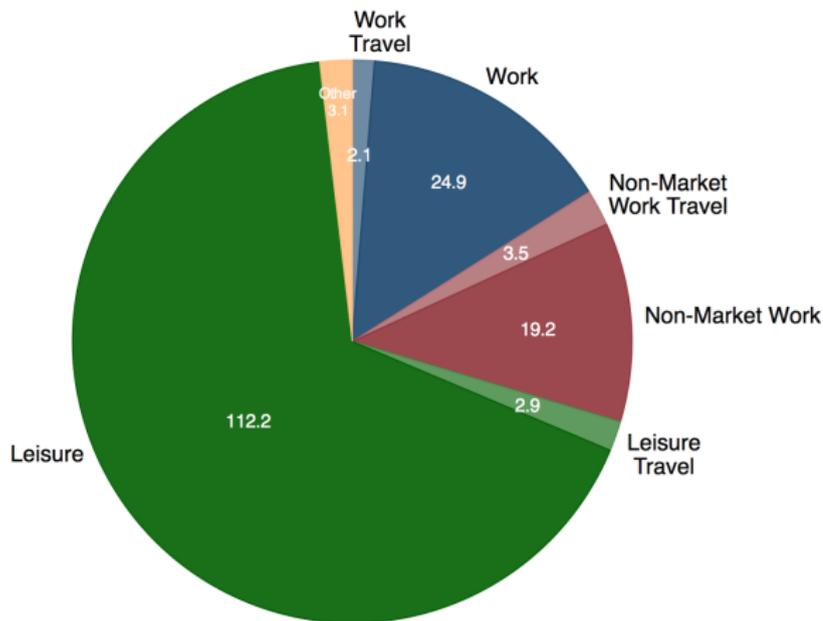
- Economizing on Travel
  - Defined as changes in the ratios of travel to non-travel time related to the same category of activity;
  - Most likely caused by technology or gasoline price fluctuations.
- Shifts in Time Allocation
  - Shifts of time among activities with different travel intensity;
  - Various substitution patterns between travel time and other time uses.

| Corresponding Non-Travel Time                    | Travel Time Use Classification | Examples of Travel Activities  |
|--|--------------------------------|--|
| Market Work: work for pay and related activities | Work Travel                    | Travel related to work, such as commuting to/from work, and non-commuting work-related travel  |
| Non-Market Work                                  | Non-Market Work Travel         | Home Production Travel, <b>Obtaining Travel</b> , Child Care Travel and Other Care Travel  |
| Leisure  | Leisure Travel                 | Travel related to <b>sports, exercises, recreation, socializing, entertainment,</b> eating and drinking, volunteering and other leisure activities |
| Other Time Uses                                  | Other Travel                   | Travel related to education and other activities   |

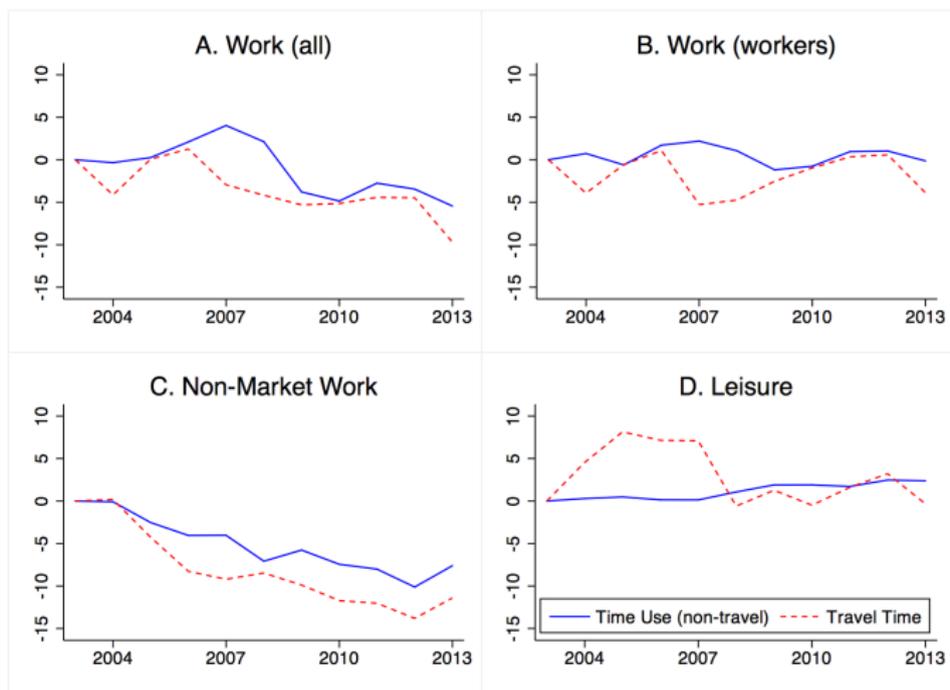
# Two Historical Periods

- First focus on 2003-2013
  - Annual data
  - Consistent measures
  - Age range:  $\geq 18$
- The longer sample of 1975-2013
  - 1975, 1985, 1993, 2003-2013
  - Nearly consistent measures but not perfect
  - Age range:  $\geq 18$

# Travel-Intensive and Non-Intensive Activity (2003)



# Economizing on Travel or Shift in Time Allocation



# Substitution Patterns of Travel and Other Time Uses

- Forming 120 cells based on demographics
- Computing year-to-year or ten-year differences in time use categories for all cells
- Running the regression

$$\Delta H_{it}^j = \alpha^j + \beta^j \Delta H_{it}^{travel} + \varepsilon_{it}^j$$

- Interpretation: not causal, however,
  - Negative Coefficients: substitutable
  - Positive Coefficients: complementary

Table 6: Substitution Patterns across Time Use Categories (2003-2013)

| Time Use Category<br>(Non-Travel Time) | Sample         | Baseline       |             | Demographics   |             | Time Dummies   |             | Demo + Time    |             |
|--|----------------|----------------|-------------|----------------|-------------|----------------|-------------|----------------|-------------|
|  | Average<br>(1) | $\beta$<br>(2) | S.E.<br>(3) | $\beta$<br>(4) | S.E.<br>(5) | $\beta$<br>(6) | S.E.<br>(7) | $\beta$<br>(8) | S.E.<br>(9) |
| <b>Work</b>                            | 24.39          | -9.75          | (7.24)      | -9.80          | (7.27)      | -10.01         | (7.20)      | -10.05         | (7.22)      |
| <b>Non-market Work</b>                 | 18.36          | -11.84*        | (7.10)      | -11.83*        | (7.13)      | -12.02*        | (7.05)      | -12.01*        | (7.08)      |
| - Child Care                           | 3.64           | -5.19***       | (1.85)      | -5.22***       | (1.85)      | -4.96***       | (1.87)      | -4.99***       | (1.88)      |
| - Other Care                           | 0.83           | 3.09           | (2.56)      | 3.10           | (2.57)      | 3.13           | (2.50)      | 3.14           | (2.51)      |
| - Obtaining Goods/Services             | 3.14           | 12.45***       | (2.61)      | 12.46***       | (2.63)      | 12.47***       | (2.64)      | 12.49***       | (2.65)      |
| - Home Production                      | 10.75          | -22.19***      | (5.05)      | -22.18***      | (5.08)      | -22.66***      | (5.05)      | -22.65***      | (5.07)      |
| <b>Home Leisure</b>                    | 86.41          | -113.53***     | (15.44)     | -113.50***     | (15.49)     | -113.98***     | (15.52)     | -113.95***     | (15.58)     |
| - Computer + TV                        | 20.35          | -53.37***      | (9.54)      | -53.33***      | (9.58)      | -53.14***      | (9.58)      | -53.18***      | (9.63)      |
| - Sleeping                             | 60.33          | -53.37***      | (10.17)     | -53.34***      | (10.22)     | -53.90***      | (10.16)     | -53.88***      | (10.21)     |
| - Other Home Leisure                   | 5.73           | -6.87          | (4.19)      | -6.82          | (4.21)      | -6.93          | (4.19)      | -6.89          | (4.21)      |
| <b>Outside Leisure</b>                 | 9.71           | 17.76*         | (9.23)      | 17.80*         | (9.26)      | 17.75*         | (9.29)      | 17.79*         | (9.33)      |
| - Exercise and Sports                  | 2.06           | 10.33***       | (3.52)      | 10.34***       | (3.53)      | 10.24***       | (3.53)      | 10.24***       | (3.54)      |
| - Socializing                          | 7.06           | 5.94           | (8.40)      | 5.98           | (8.43)      | 6.01           | (8.38)      | 6.05           | (8.41)      |
| - Entertainment and Arts               | 0.60           | 1.49           | (1.38)      | 1.48           | (1.39)      | 1.51           | (1.38)      | 1.50           | (1.39)      |
| <b>Other Leisure</b>                   | 17.57          | 17.77***       | (5.95)      | 17.75***       | (5.98)      | 18.42***       | (5.90)      | 18.40***       | (5.93)      |
| - Garden and Pet                       | 2.05           | -2.92          | (2.55)      | -2.92          | (2.56)      | -2.86          | (2.50)      | -2.87          | (2.51)      |
| - Eating                               | 7.85           | 5.53**         | (2.54)      | 5.54**         | (2.47)      | 5.52**         | (2.45)      | 5.53**         | (2.46)      |
| - Personal Care                        | 4.73           | 5.19**         | (2.19)      | 5.20**         | (2.20)      | 5.37**         | (2.19)      | 5.38**         | (2.20)      |
| - Self Care                            | 0.61           | 0.49           | (2.53)      | 0.51           | (2.54)      | 0.75           | (2.56)      | 0.76           | (2.57)      |
| - Own Medicare                         | 0.36           | 3.84**         | (1.54)      | 3.84**         | (1.55)      | 3.85**         | (1.56)      | 3.84**         | (1.56)      |
| - Civic                                | 1.97           | 5.63**         | (2.50)      | 5.59**         | (2.51)      | 5.79**         | (2.48)      | 5.75**         | (2.49)      |
| <b>Other</b>                           | 3.02           | -0.41          | (8.01)      | -0.43          | (8.04)      | -0.16          | (8.03)      | -0.19          | (8.06)      |
| - Education                            | 1.63           | -1.17          | (7.19)      | -1.22          | (7.22)      | -1.23          | (7.23)      | -1.28          | (7.27)      |
| - Other (excluding education)          | 1.39           | 0.77           | (3.96)      | 0.79           | (3.98)      | 1.07           | (3.92)      | 1.09           | (3.93)      |

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ 

Note: All coefficients are multiplied by 100.

# Substitution Patterns across Time Use Categories (2003-2013)

- For every 100-hour reduction in total travel,
- Complementary time uses (selected):
  - 12-hour reduction in time on obtaining goods and services (non-travel portion)
  - 10-hour reduction in exercise and sports
- Substitutionary time uses (selected)
  - 53-hour in time on entertainment using computer&TV
  - 53-hour on sleeping
  - 22-hour on home production (housework)

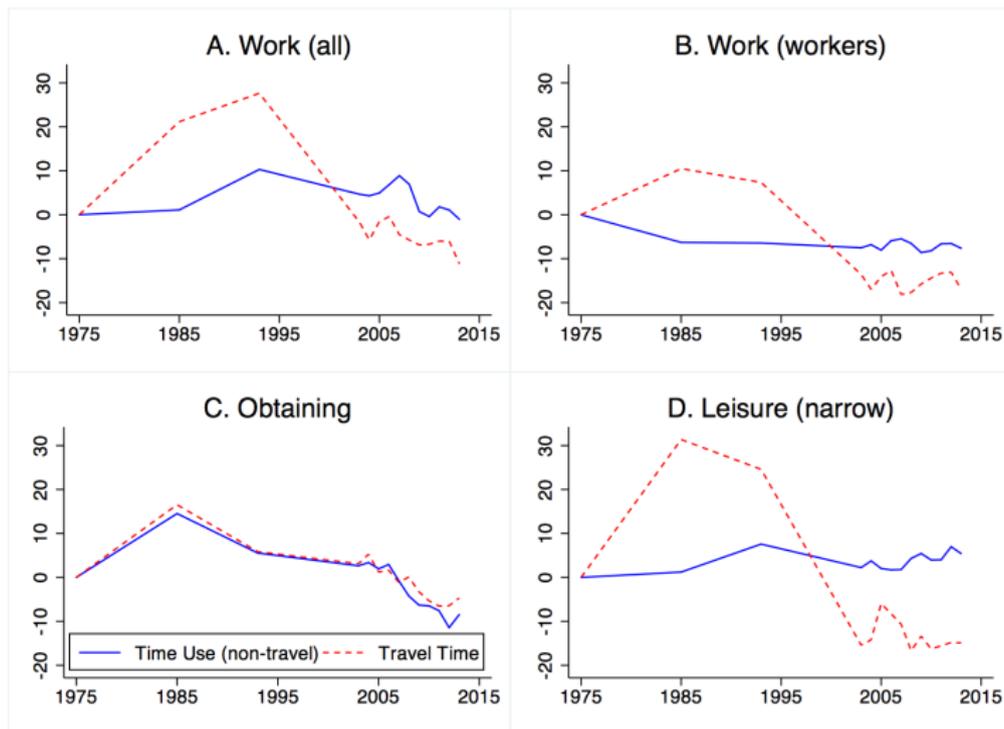
# Substitution Patterns across Time Use Categories (2003-2013)

- For every 100-hour reduction in total travel,
- Complementary time uses (selected):
  - 12-hour reduction in time on obtaining goods and services (non-travel portion)
  - 10-hour reduction in exercise and sports
- Substitutionary time uses (selected)
  - 56-hour in time on entertainment using computer&TV
  - 56-hour on sleeping
  - 24-hour on home production (housework)

# Travel Time Allocation over a Long Horizon: 1975-2013

- For measure consistency,
  - Work travel (market work)
  - Obtaining travel (obtaining; nonmarket work)
  - Leisure travel (socializing, recreation and passive leisure; core leisure)
- 62-74% of total travel, around 40% of time use

# Time Use and Travel Time: 1975-2013



# Substitution Patterns across Time Use Categories (1975-2013)

- For every 100-hour reduction in total travel,
- Complementary time uses (selected):
  - 21-hour reduction in time on civil activities
  - 11-hour reduction in socializing
  - 9-hour reduction in exercise and sports
  - 9-hour reduction in obtaining goods and services
- Substitutionary time uses (selected):
  - 56-hour on sleeping
  - 40-hour in time on entertainment using TV
  - 25-hour on leisure at home not including TV

# Summary on Time Allocation

|                          | 1975-1993   | 1993-2003   | 2003-2013                             |
|--------------------------|---|---|---------------------------------------|
| Demographic shift        | 45%   | 16%   | 2%                                    |
|                          | Baby boomers coming of age  | Baby boomers aging  | Shift of old workers to retirement    |
|                          | Shift of women into work status   | Decline in relative working population.                               | Shift of younger pop. to non-work     |
|                          | Increase in education level   | Slowdown in education growth  | Stable education growth               |
| Shift of time allocation | Both work and leisure travel increase with corresponding time use   | Work and leisure (narrow) travel decline with corresponding time use. | Shift from non-market work to leisure |
| Economizing on travel    | Opposite to economizing   | Possible economizing  | No strong evidence                    |
| Substitution Patterns    | Complementary: obtaining goods & services, and etc.<br>Substitutionary: Entertainment using computer & TV, Sleeping |   |                                       |

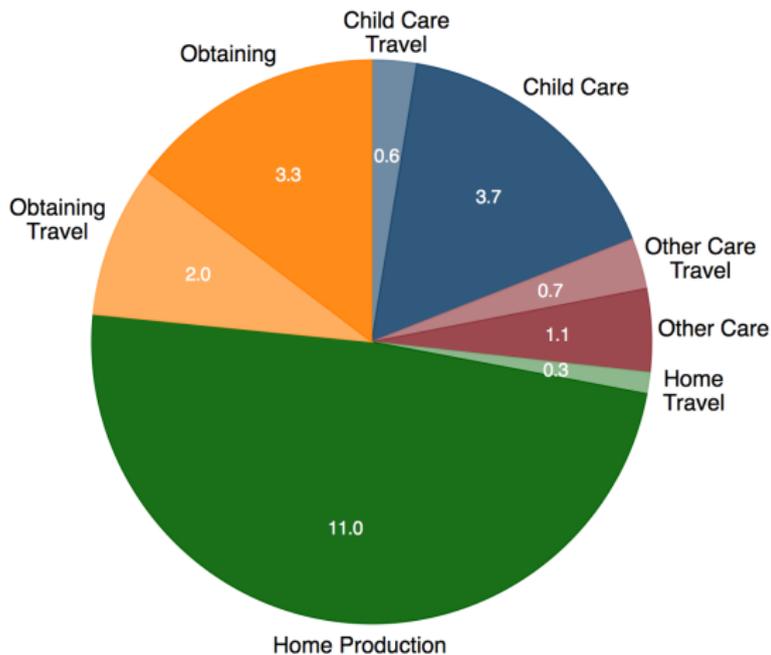
# Model Ingredients

- Different growth rates of productivity in market, non-market and leisure sector
- Gasoline price change
- Change of technology in travel sector

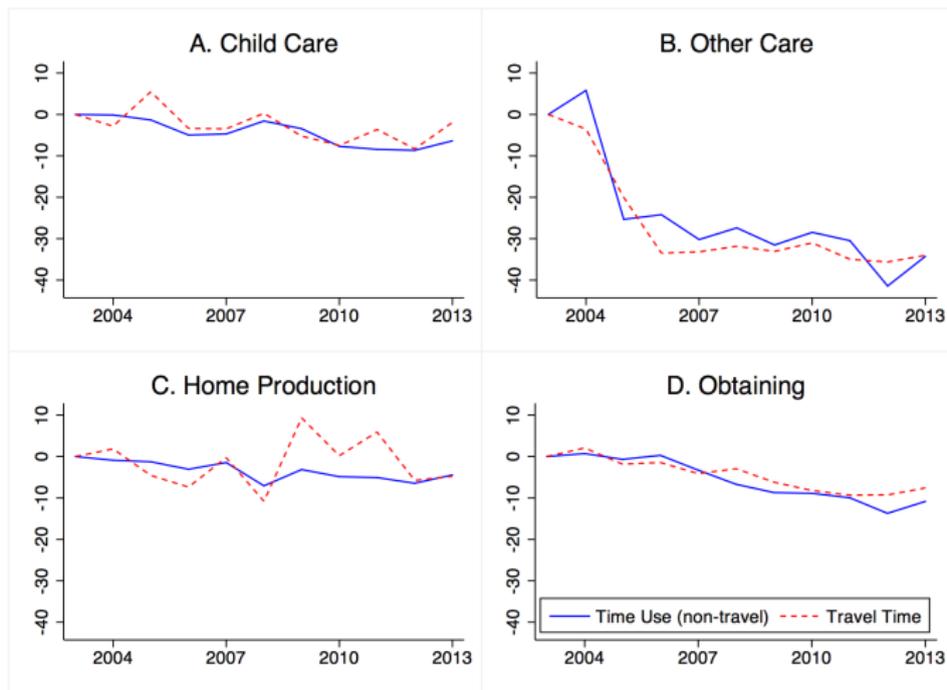
In addition to

- Aging of baby boomers
- Changes in labor force participation
- Changes in education level

# A Close Look at Non-Market Work Travel



# Evolution of Non-Market Work Travel



# Decomposition of Disaggregated Travel Time

