Travel Time Use over Five Decades

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November 17, 2015

Outline

Overview

Related Literature

Demographics Shifts

Aggregate Forces

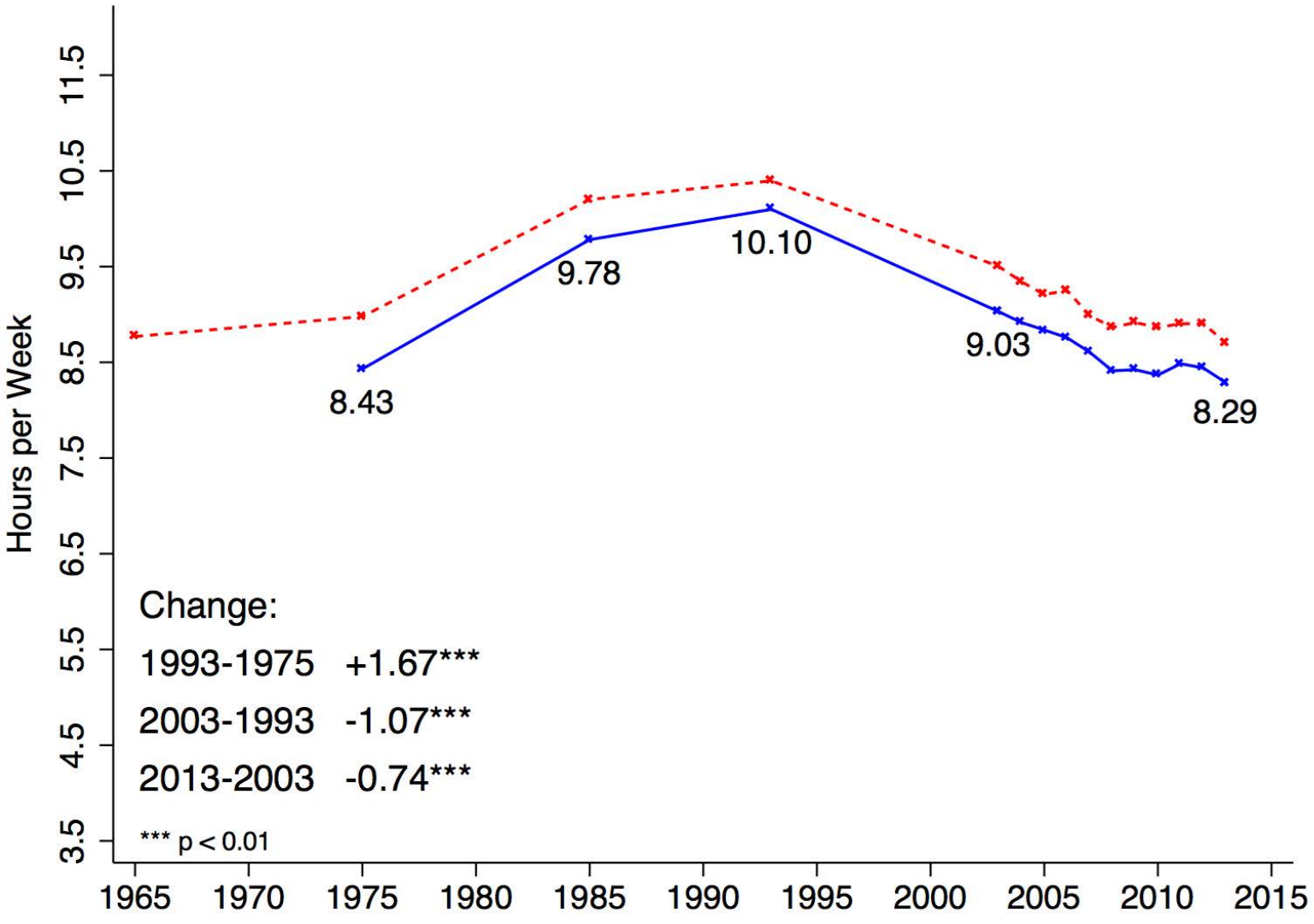
Summary

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	Sample Size	Sample 1 Size	Sample 2 Size	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)

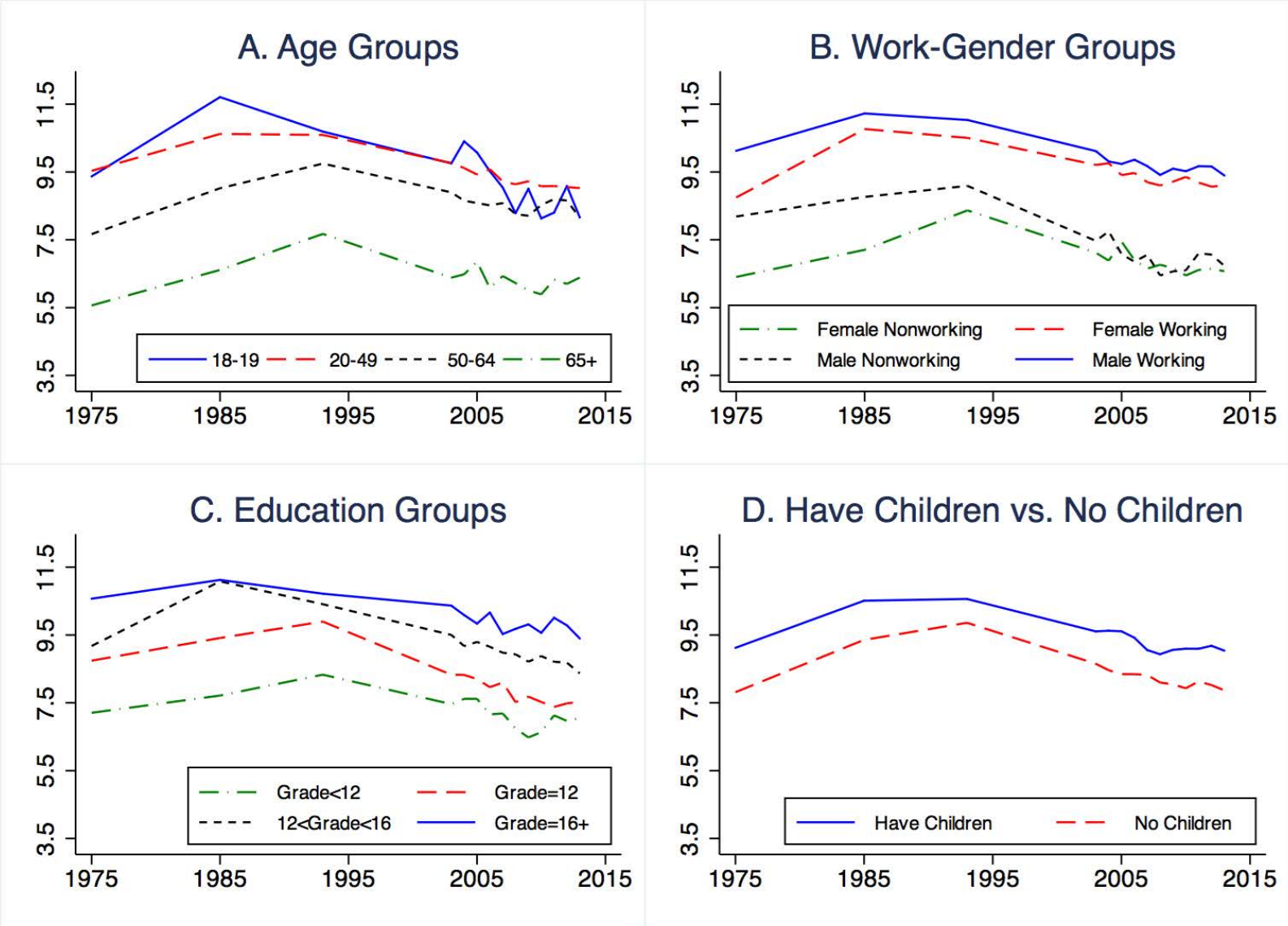
- National Personal/Household Travel Survey

  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 1975-2013	Difference 1993-1975	Difference 2003-1993	Difference 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

- $\overline{Y}_{t_1} - \overline{Y}_{t_0} = (\overline{X}_{t_1} - \overline{X}_{t_0})'\widehat{\beta}_{t_0} + \overline{X}'_{t_1}(\widehat{\beta}_{t_1} - \widehat{\beta}_{t_0})$
- 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

	1975-1993	1993-2003	2003-2013
Difference	1.67***	-1.07***	-0.74***
Explained	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*
Unexplained	0.91**	-0.89***	-0.73***

Panel B: Ratio Relative to Difference

	1975-1993	1993-2003	2003-2013
Explained	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%
Unexplained	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

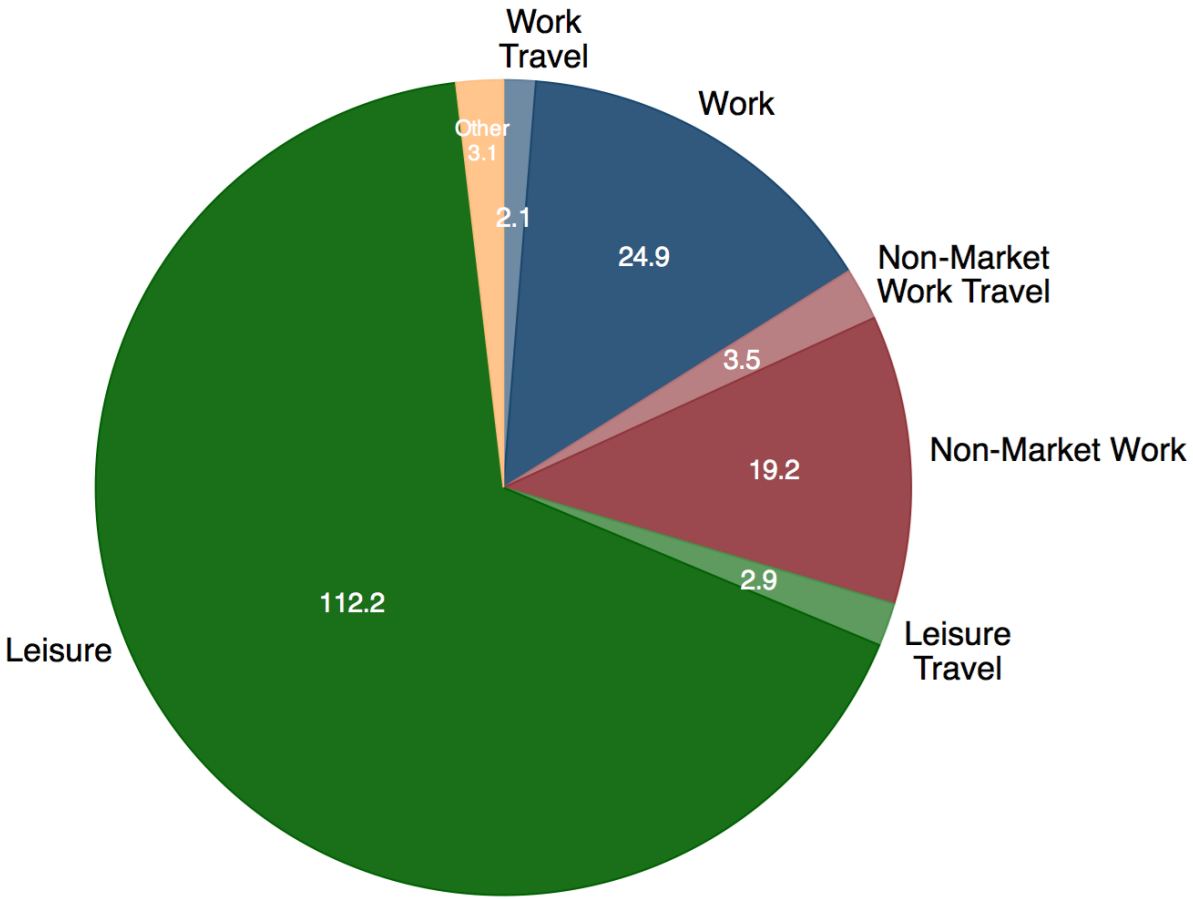
  –Shifts of time among activities with different travel intensity;
  –Various substitution patterns between travel time and other time uses.

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, Obtaining Travel, Child Care Travel and Other Care Travel
Leisure	Leisure Travel	Travel related to sports, exercises, recreation, socializing, entertainment, eating and drinking, volunteering and other leisure activities
Other Time Uses	Other Travel	Travel related to education and other activities

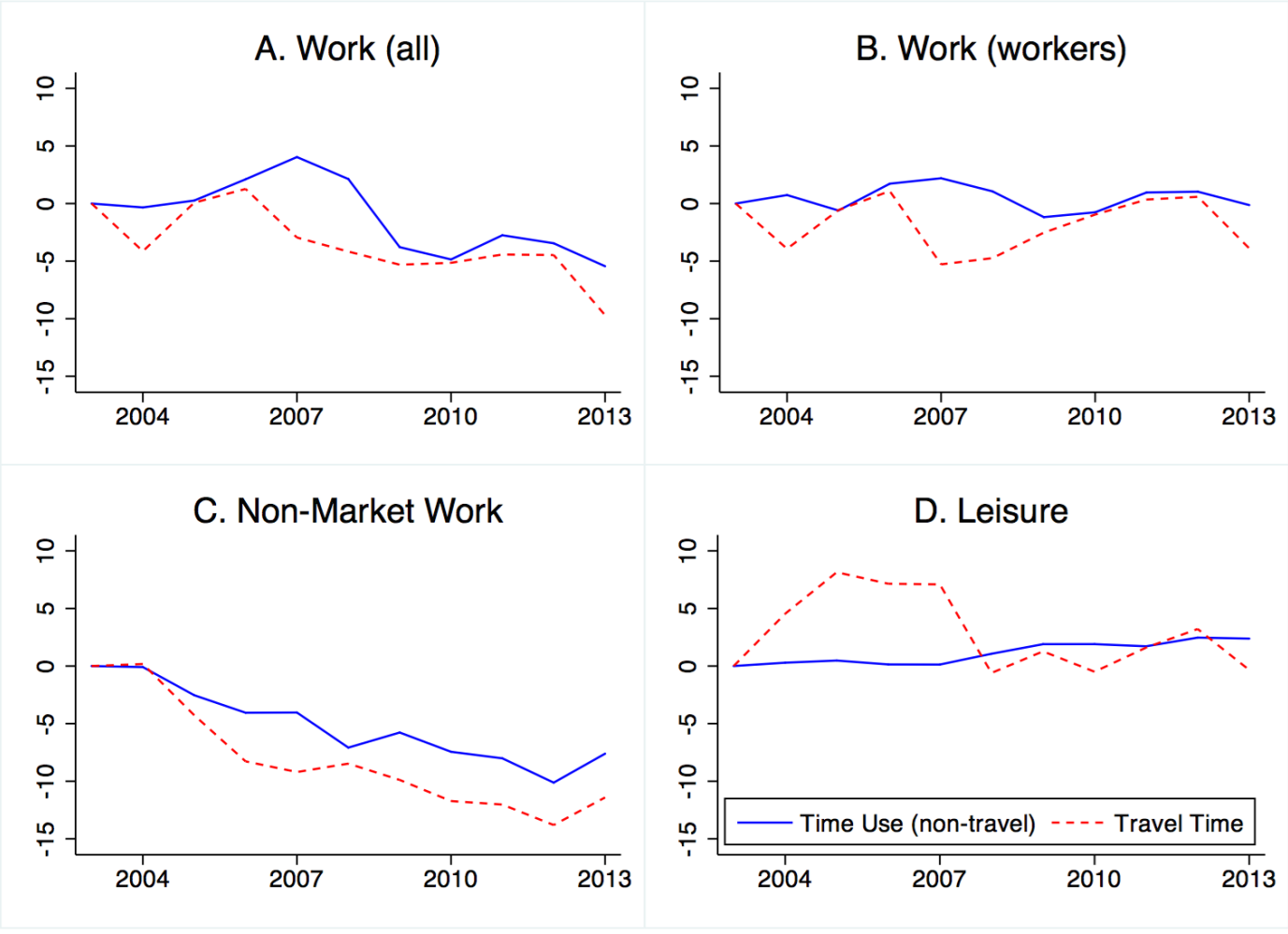
Two Historical Periods

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

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

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

Time Use Category (Non-Travel Time)	Sample Average	Baseline		Demographics		Time Dummies		Demo + Time	
		β	S.E.	β	S.E.	β	S.E.	β	S.E.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Work	24.39	-9.75	(7.24)	-9.80	(7.27)	-10.01	(7.20)	-10.05	(7.22)
Non-market Work	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)
Home Leisure	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)
Outside Leisure	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)
Other Leisure	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)
Other	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,

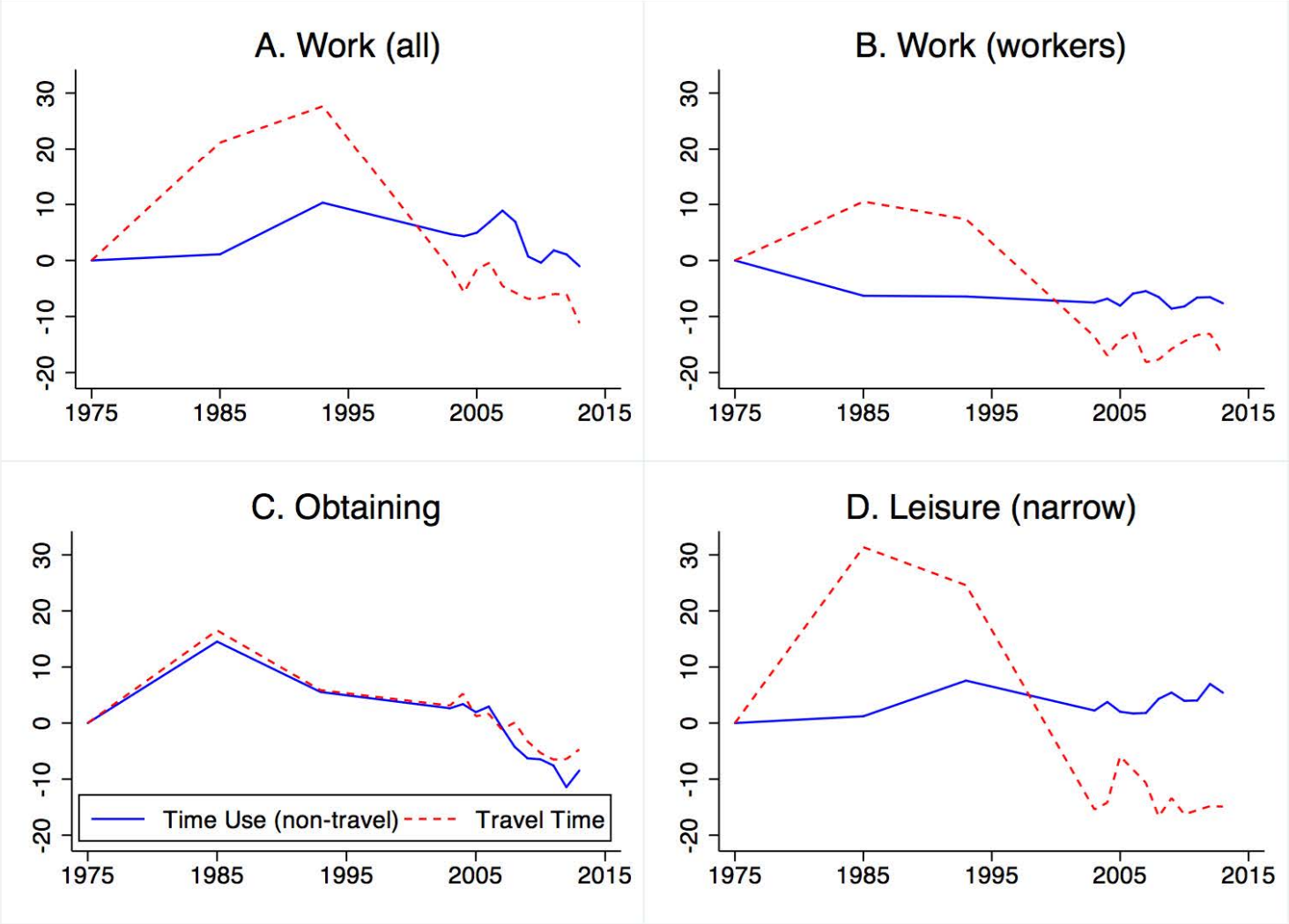
  –Work travel (market work)

  –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. Substitutionary: Entertainment using computer & TV, Sleeping		

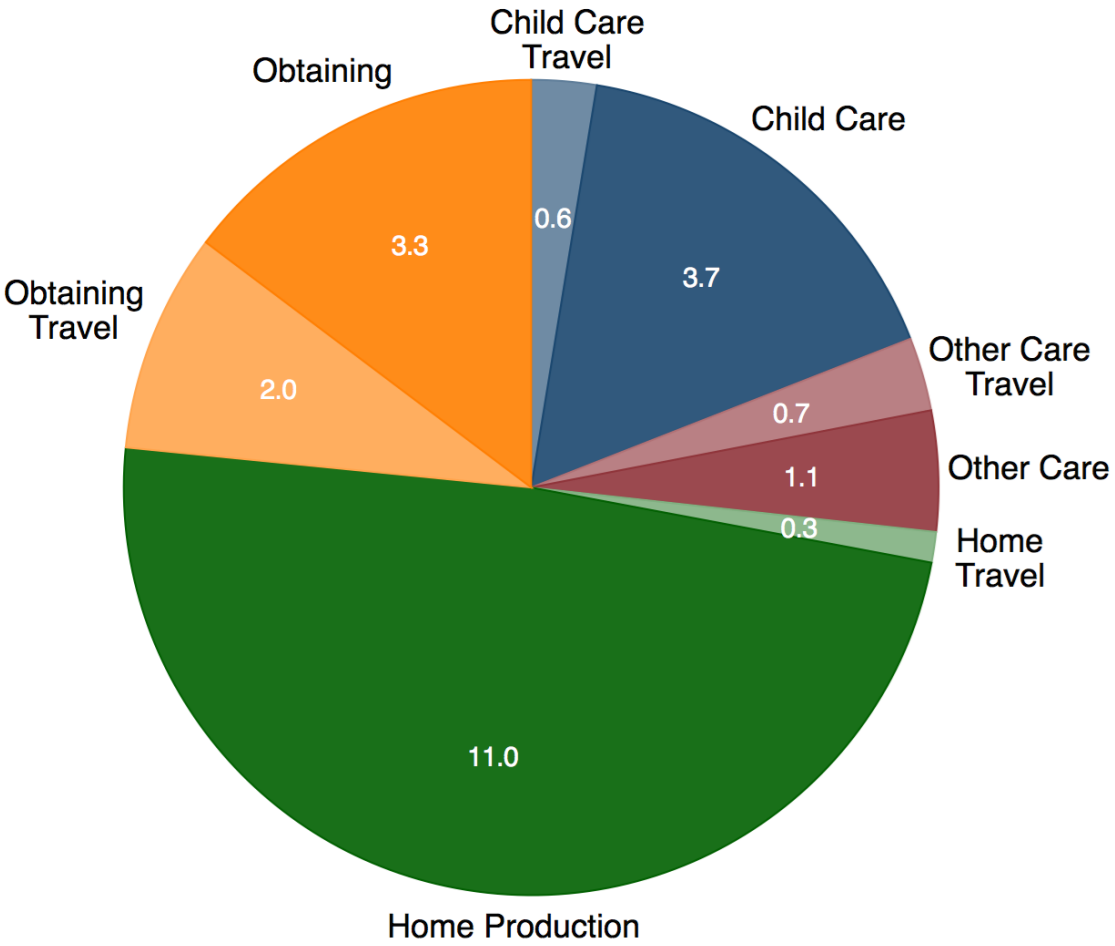
Model Ingredients

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

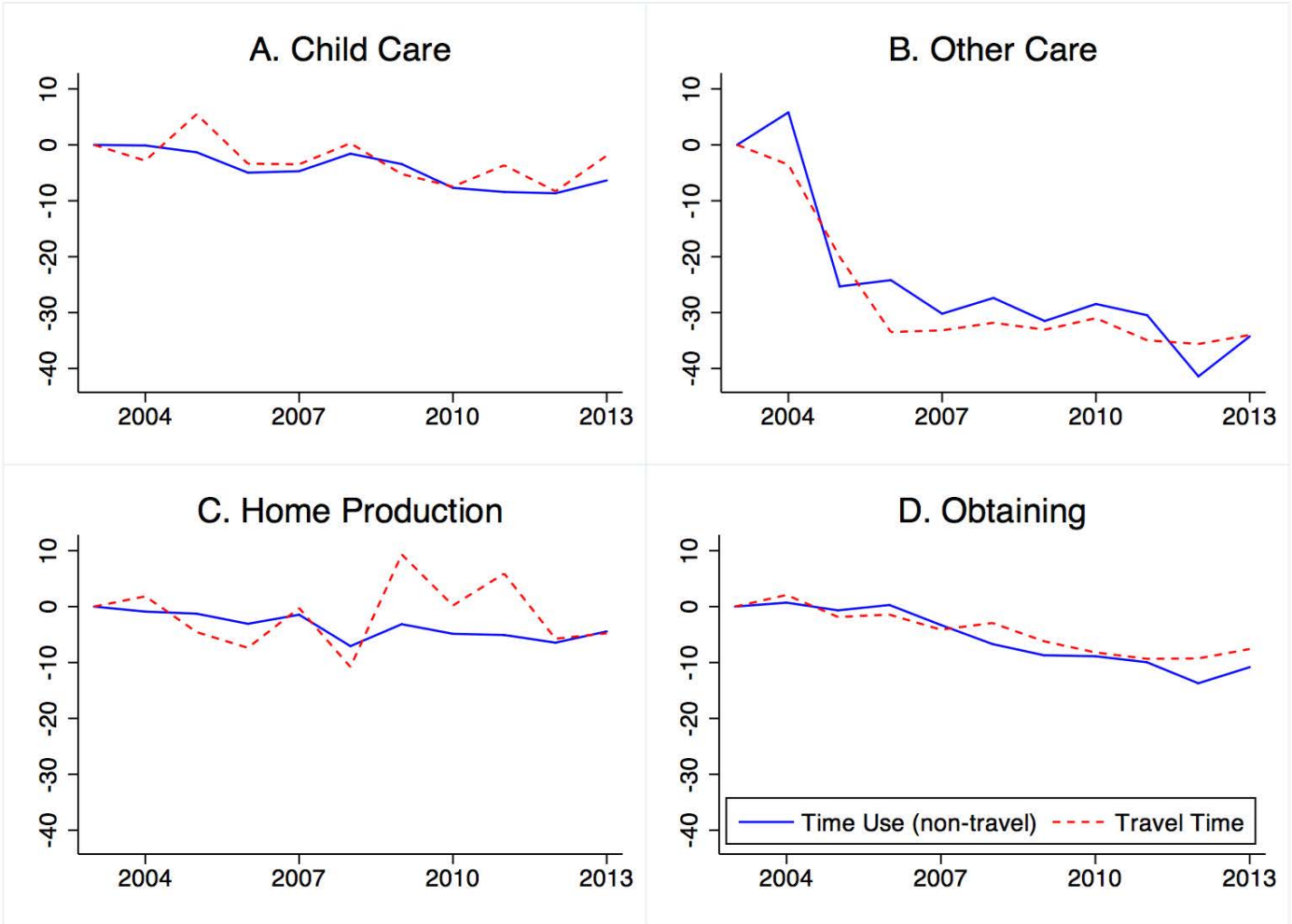
In addition to

- 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