Exploring factors to decrease in car ownership among young adults with multiple data sources

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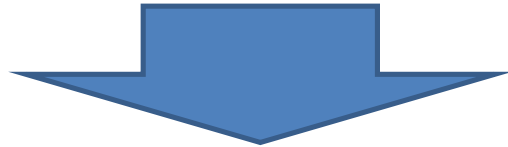
Outline

- Introduction

- Three potential factors in Japan

- Aggregate descriptive analysis

- Disaggregate modeling

- Conclusion

Young people's mobility development in industrialized countries

- For decades: in line with the growth of per capita travel
  - Increasing motorization and car use

- More recently: changes in travel behavior
  - Decreasing car orientation and reduced overall travel
  - 'Peak Car', 'Peak Travel'
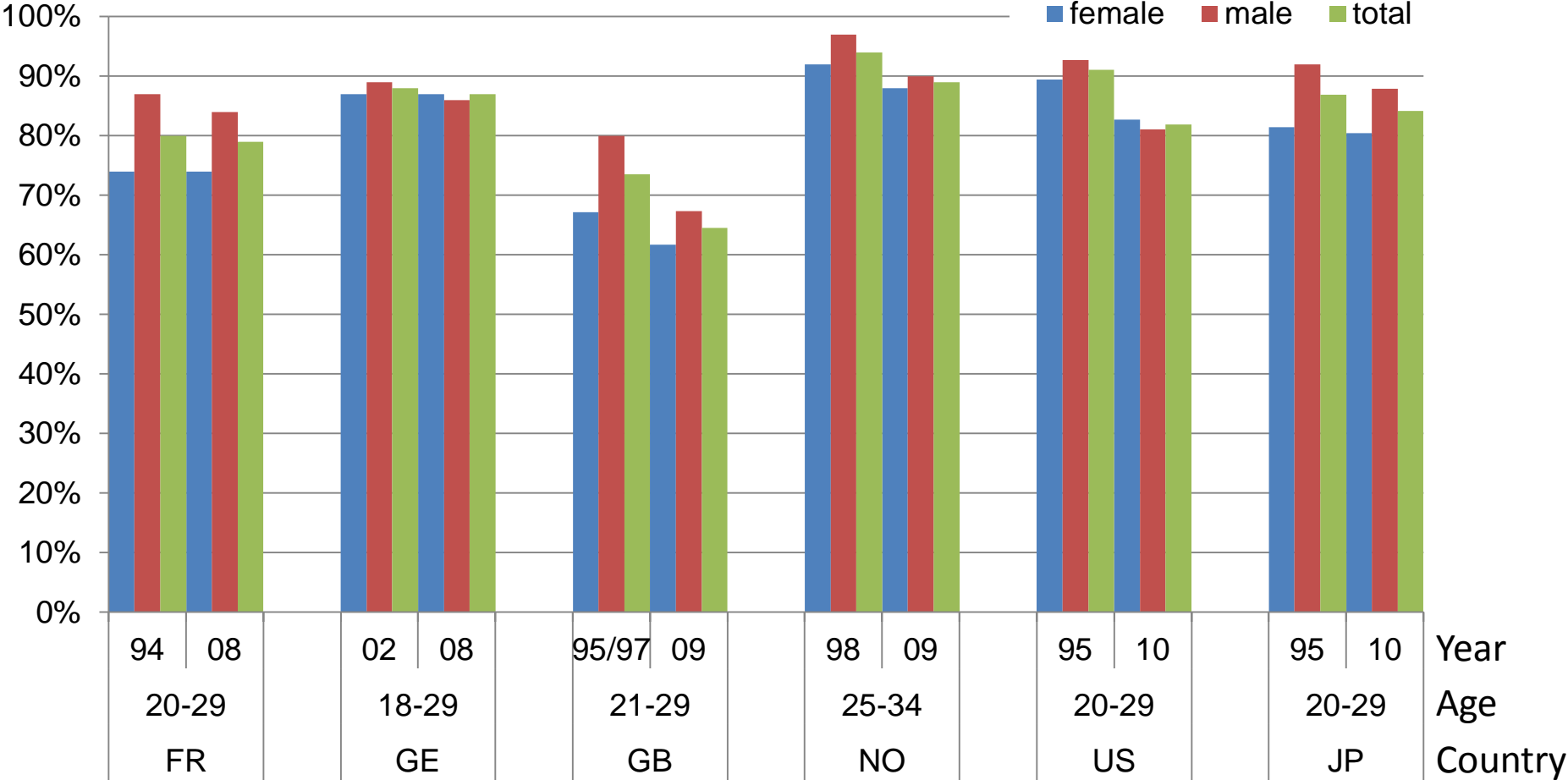
Objectives

- Explore factors for downward trend in <u>Japan</u>
  - One of the most industrialized
  - Earliest motorized in Asia
  - Aging and decreasing population

Focus on young adults (age 20-29):
- More mobile than any other age group
- Shapes future travel demand
- More likely to change travel behavior in response to changing conditions
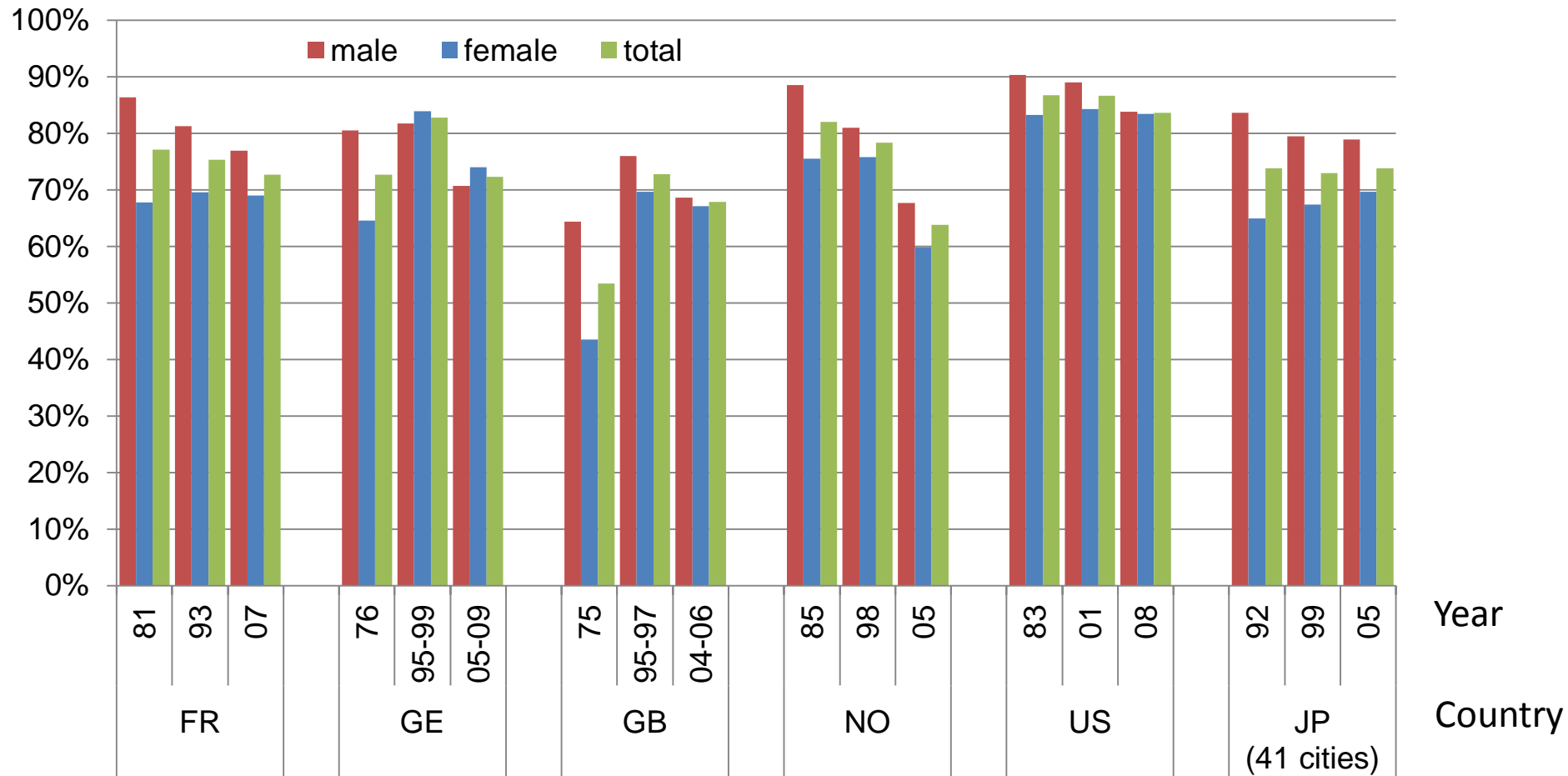
Driver's license

Kuhnimhof et al. (2012)

- Decline especially for men

Car availability (Age 20-29)

- License holding & vehicle ownership in household

- Decline for men
- Increase for women in Japan

Kuhnimhof et al. (2012)

Suggested potential factors

Delbosc & Currie (2013)	Goodwin (2012)	Kuhnimhof et al. (2012)
Life stage		• Increasing tertiary education • Late workforce participation • Starting a family late
Affordability	• Prices & incomes	
Location & transport	• Land use • relative quality and reliability of travel	• Increasing urban population • Discouraging driving • LCC air & high speed rail
Driver licensing regulation		
Attitudes	• Social/technical patterns and preferences • Work, shopping, entertainment and leisure	• environmental awareness and pragmatism
E-communication	• Mobile internet access	• ICT

Three potential factors in Japan
(M1F1 Research Institute, 2007)

- Convenience of transit at metropolitan areas (location & transport)
- Financial constraint (affordability)
- Diversification of hobby (attitude & E-communication)

[Not considered]
- Driver licensing regulation: hasn't change much
- Life stage: (explained later)
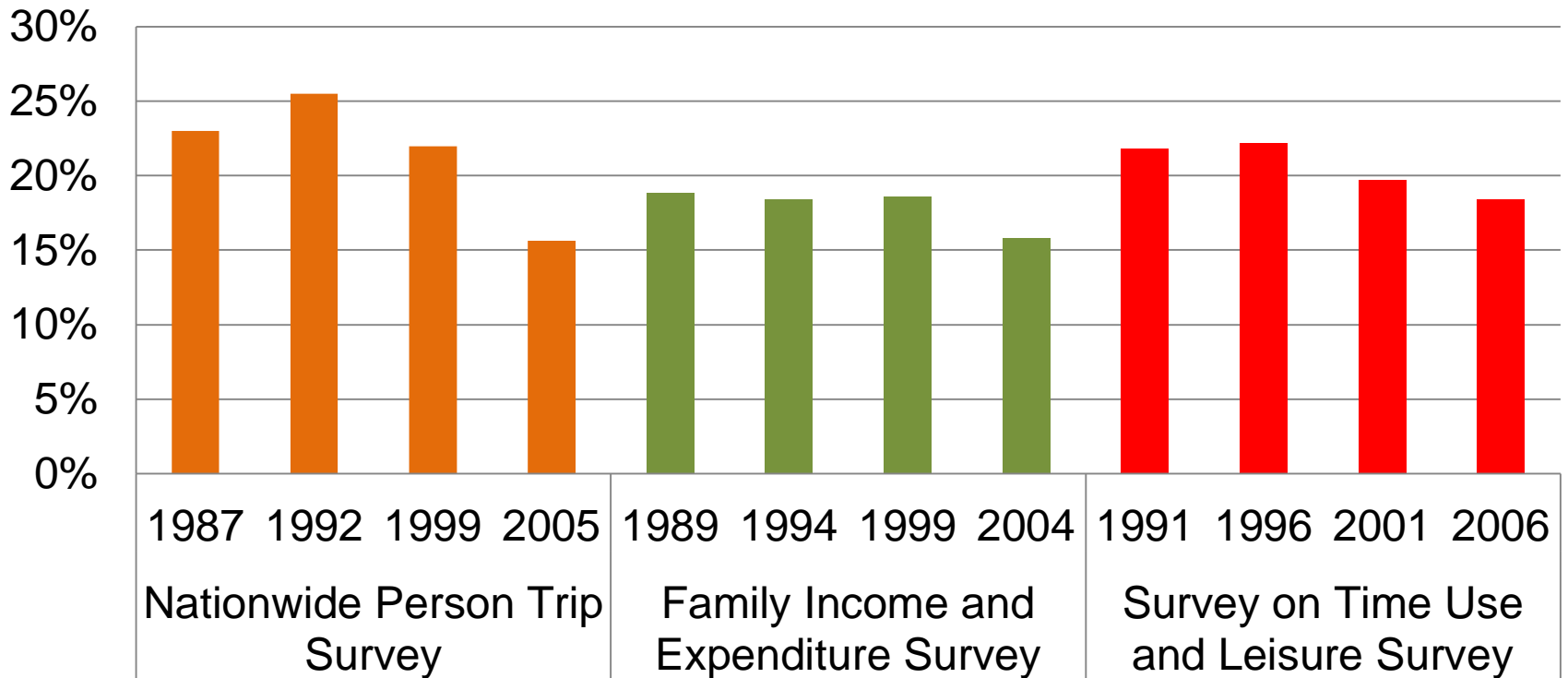
Data sets

Needs for information on

- Long-term change of multiple dimension

-> Multiple data integration

- Nationwide Person Trip Survey
- Family Income and Expenditure Survey
- Survey on Time Use and Leisure Activity
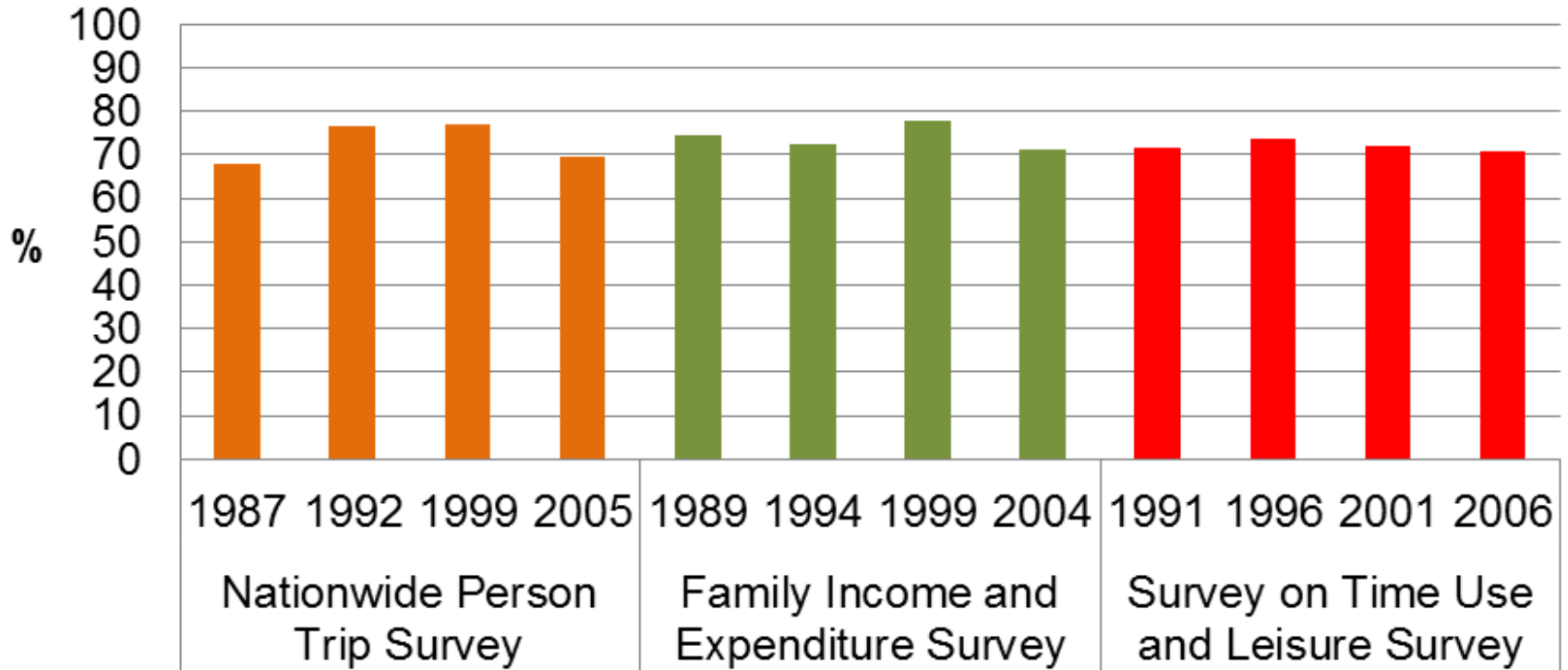
Repeated cross-section with large sample size

Rate of household head in twenties

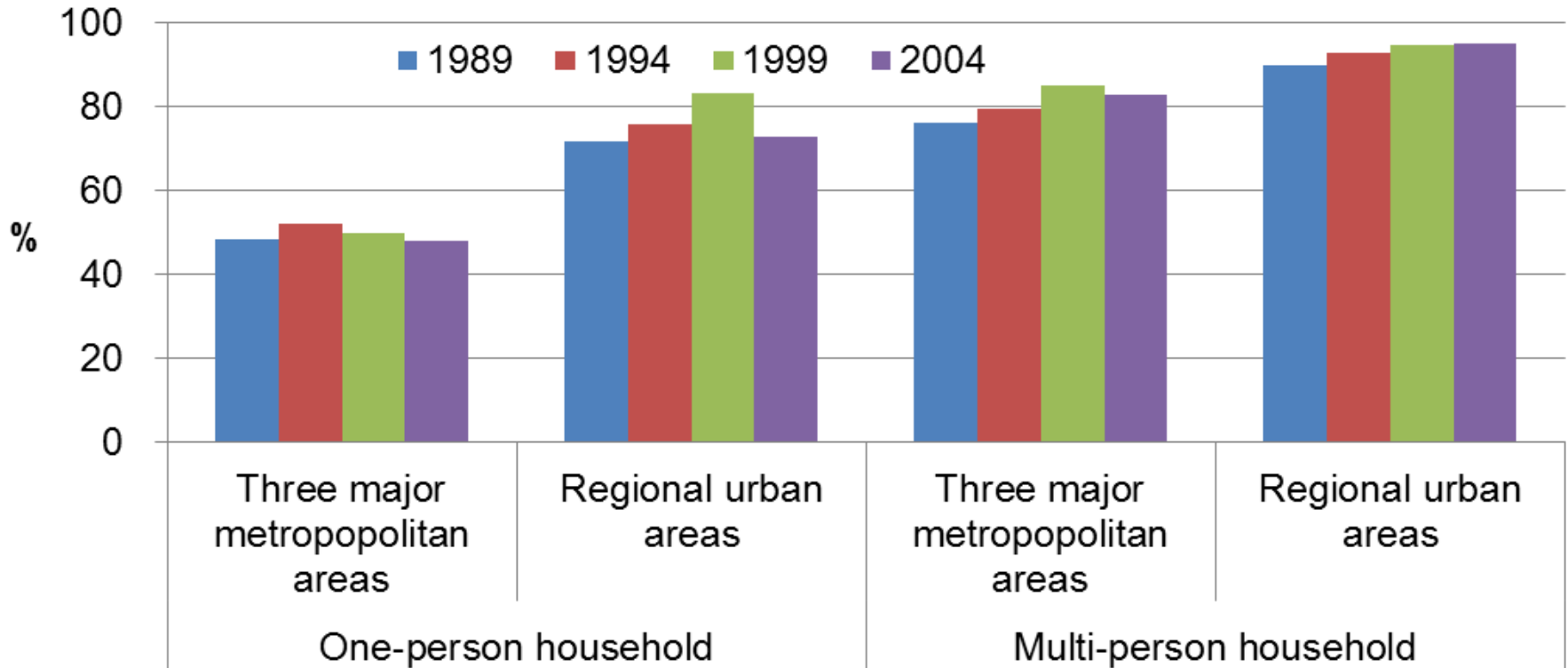- Increasing age for starting a family

Household car ownership rates

- Household with household head of twenties

- Slight variation among surveys, but decreases in this century
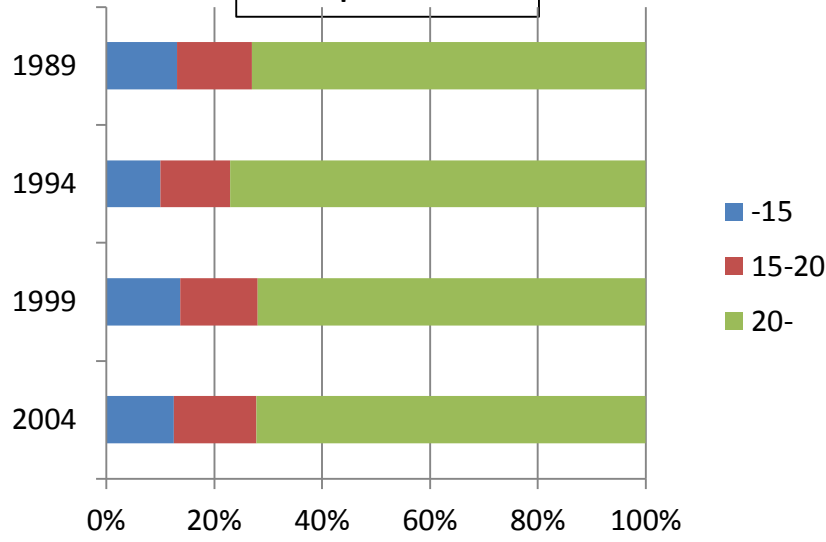
Car ownership by region

- Lower and decreasing at three major met. areas
  - Public transit & cost for parking space?

Car ownership of multi-person household by disposal income (in 10,000JPY)

Three major metropolitan areas

Regional urban areas

Sample share

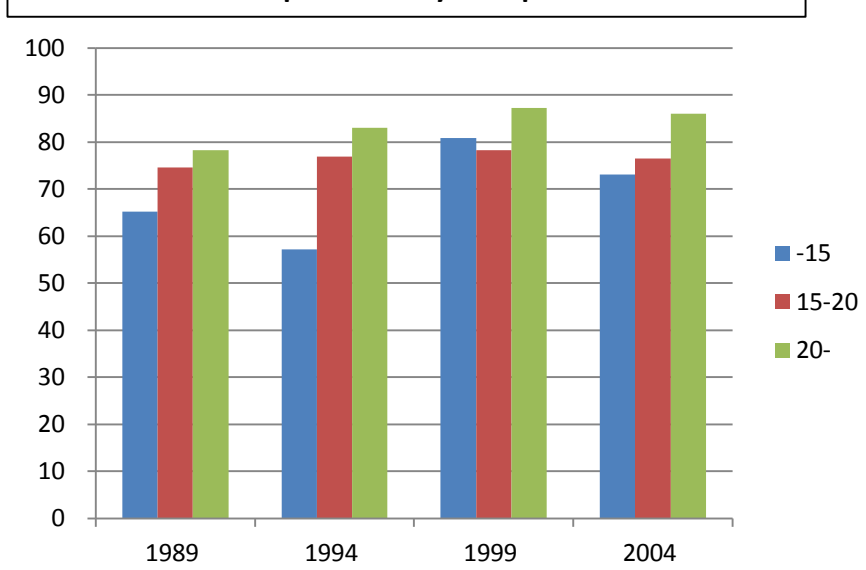Car ownership rate by disposal income

- Not significant decrease

Car ownership of one-person household by disposal income (in 10,000JPY)
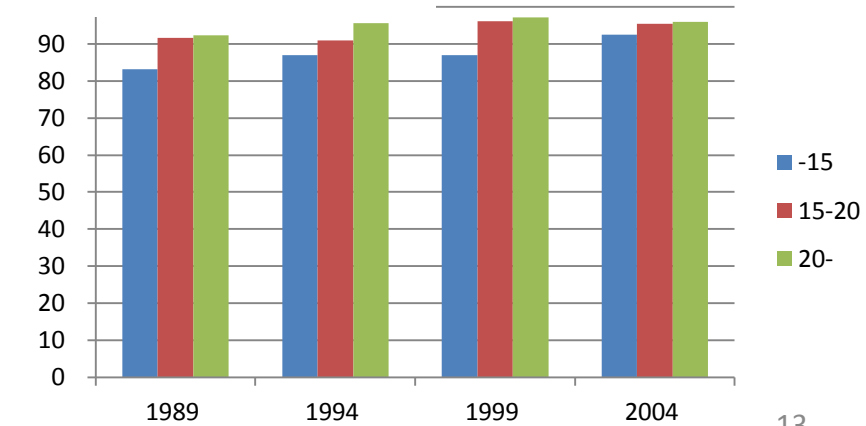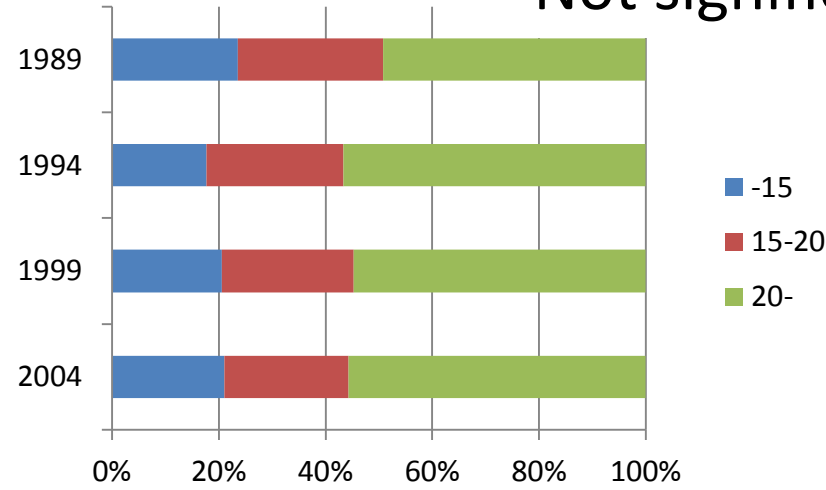

Three major metropolitan areas

Sample share

Car ownership rate by disposal income

- Decrease even in high income household
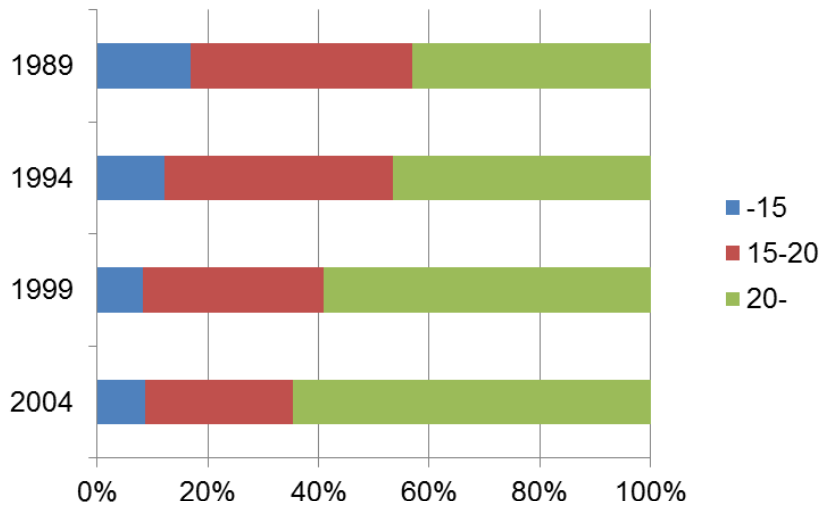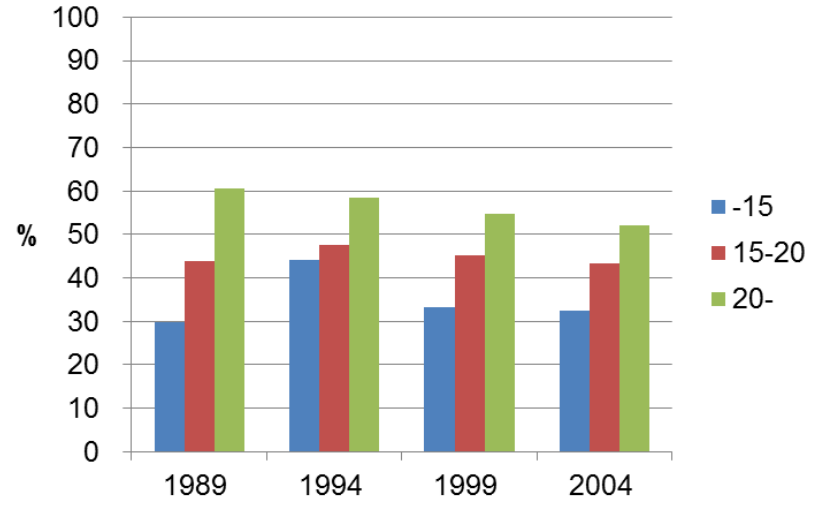
Regional urban areas
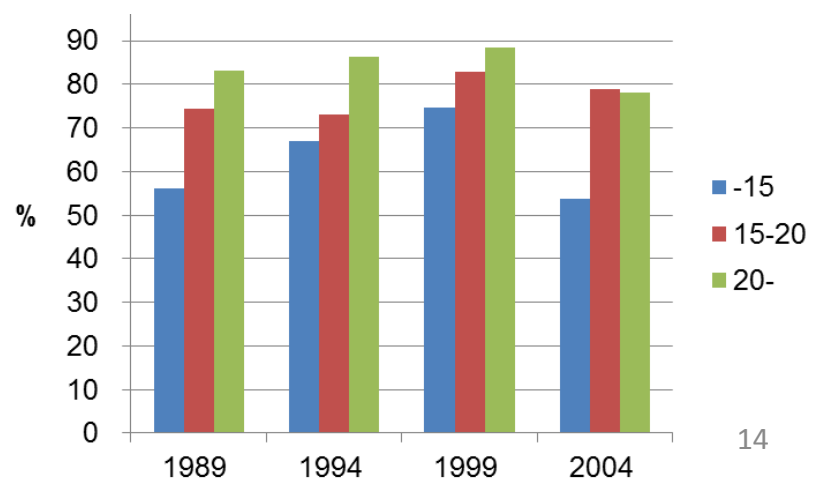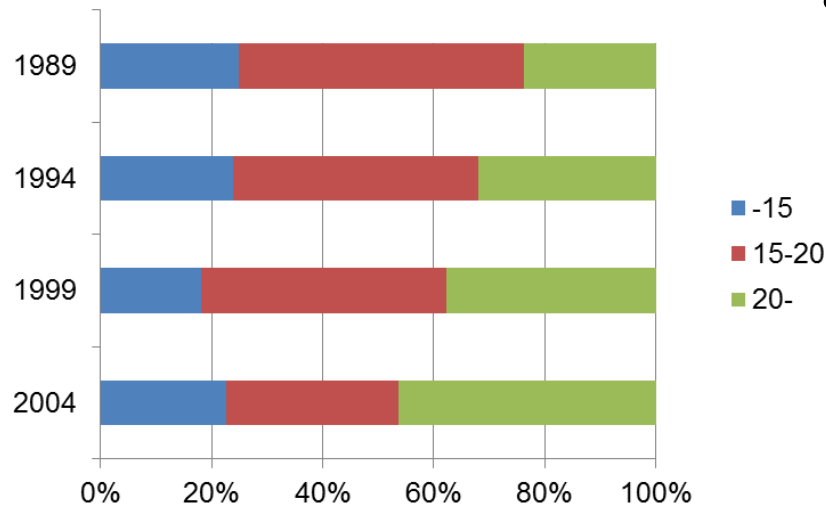
Goods & service interests ranking for young adults (JAMA, 2009)

	20 yrs ago (40s to 50s)		10 yrs ago (20s to 30s)		Current college students	
1	Fashion	35.7%	PC	50.7%	PC	62.1%
2	Domestic trip	34.0%	Fashion	47.7%	Fashion	53.9%
3	Eat out	32.0%	Telecom device	39.7%	Potable music player	50.6%
4	Book	31.7%	Domestic trip	37.3%	Telecom device	49.9%
5	Music	31.3%	Music	37.0%	Domestic trip	44.0%
6	Movie	27.2%	Eat out	33.7%	Music	43.7%
7	**Car**	**27.0%**	Overseas trip	32.7%	Book	42.9%
8	PC	25.7%	Potable music player	31.0%	Cartoon/comics	42.0%
9	Overseas trip	23.7%	Book	31.0%	Game	38.4%
10	Audio	20.3%	**Car**	**25.3%**	Eat out	37.6%
17					**Car**	**22.8%**

Car ownership by rate of out-of-home discretionary activity time on holiday

Three major metropolitan areas

Sample share
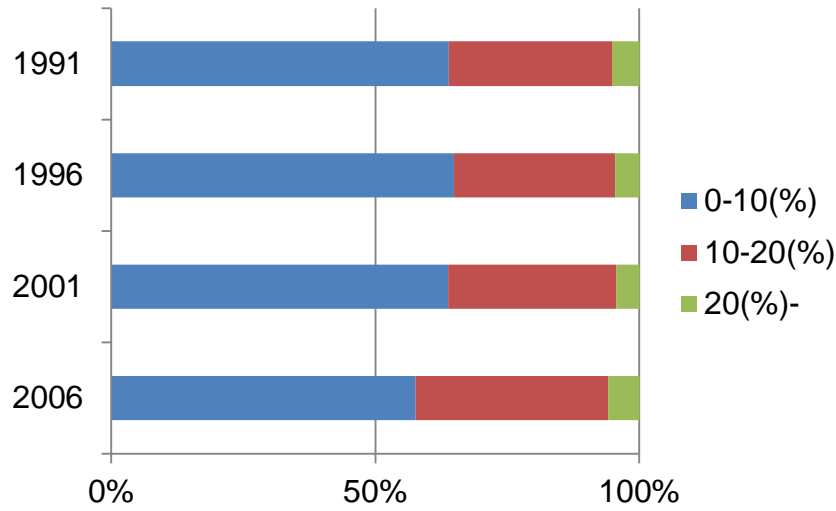
Car ownership rate by rate of discretionary activity time

Regional urban areas

16
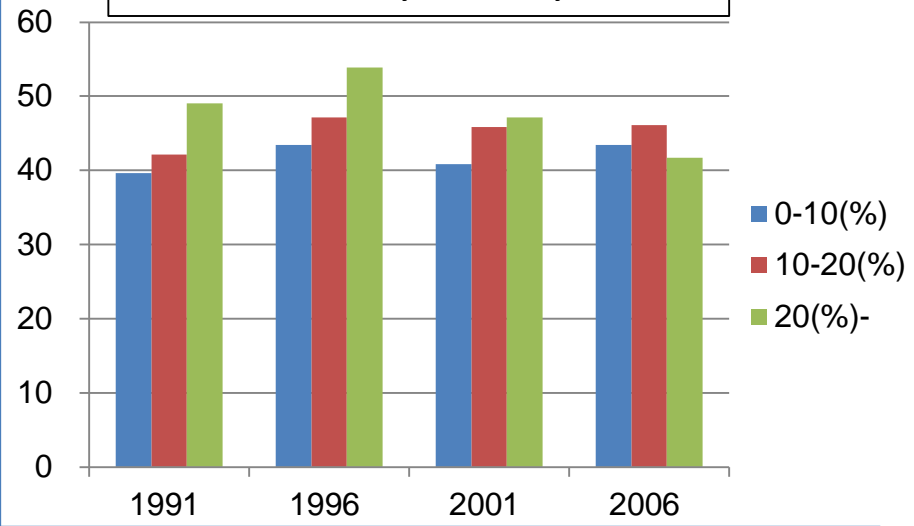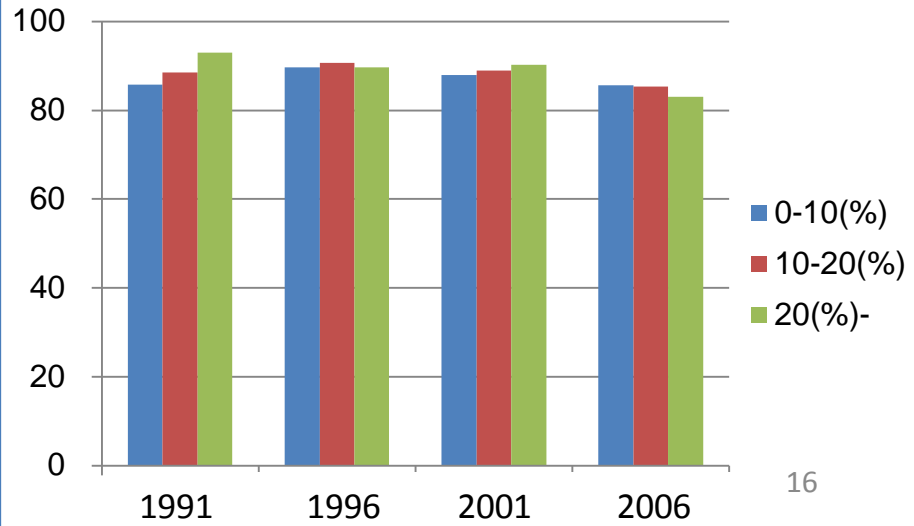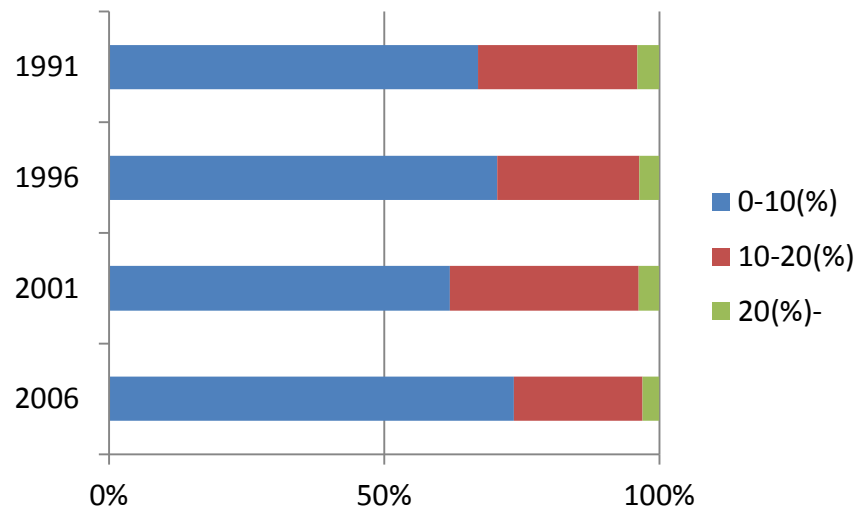
Binary probit model of car ownership

$$
\begin{aligned}
U_n^{IE} &= \beta' X_n^{IE} + \alpha' W_n^{IE} \quad + \delta' L_n^{IE} \qquad\qquad + \psi' Q_n^{IE} + \varepsilon_n^{IE} \\
U_n^{TU} &= \beta' X_n^{TU} + \alpha' W_n^{TU} \qquad\qquad + \tau' Y_n^{TU} + \gamma' Z_n^{TU} + \varepsilon_n^{TU} \\
U_n^{PT} &= \beta' X_n^{PT} \qquad\qquad + \delta' L_n^{PT} + \tau' Y_n^{PT} + \lambda' K_n^{PT} + \varepsilon_n^{PT}
\end{aligned}
$$

$$
LL = \sum d_{in} \ln\Phi\!\left(\frac{V_{in}^{IE}}{\sigma^{IE}}\right) + \sum d_{jn} \ln\Phi\!\left(\frac{V_{jn}^{TU}}{\sigma^{TU}}\right) + \sum d_{kn} \ln\Phi\!\left(\frac{V_{kn}^{PT}}{\sigma^{PT}}\right)
$$

- IE: income & expenditure survey, TU: time use survey, PT: person trip survey
- i, j, k: sample case, n: car ownership (0; no car, 1; own car)
- Different error variance is assumed among surveys
- Similar to SP-RP model w/o correlations

Survey periods and variables

- Three separate models are estimated

3 time periods	Person trip survey	Income and expenditure survey	Time use survey
1990 (87-91)	1987	1989	1991
2000 (99-01)	1999	1999	2001
2005 (04-06)	2005	2004	2006

Explanatory variables	PT	I & E	Time use
#workers, one-person household dummy	X	X	X
Detached house dummy		X	X
Three major metropolitan areas	X	X	
Region dummy (Hokkaido, Chugoku, Kyushu)	X		X
City w >1M population, <0.1M population	X		
Disposable income, ratio of expense for recreation, #PC, #TV, #audio player		X	
Holiday {discretionary activity/housekeeping/travel} time			X

Estimation results

	1990		2000		2005	
	Est.	s.e.	Est.	s.e.	Est.	s.e.
Constant (IE)	-0.512	0.15	0.123	0.12	0.283	0.18
Constant (TU)	0.041	0.06	-0.008	0.07	0.171	0.09
Constant (PT)	0.316	0.07	0.541	0.07	0.449	0.09
$1/\sigma$ (IE)	**0.610**	**0.06**	**0.939**	**0.09**	**0.689**	**0.07**
$1/\sigma$ (TU)	**1.262**	**0.11**	**1.345**	**0.13**	**1.026**	**0.09**
Sample size (total)	10522		8200		5852	
(IE)	3107		2924		2062	
(TU)	6415		4078		2855	
(PT)	1000		1198		935	
Adjusted pho-square	0.25		0.33		0.32	

Significantly different scale parameters among data sources

Estimation results (cont.)

	1990		2000		2005	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
One-person household	-0.749	-10.81	-0.692	-10.30	-0.905	-11.52
#workers	0.447	9.79	0.446	8.91	0.643	10.51
Detached house	0.398	5.41	0.490	6.17	0.782	6.44
3 major metropolitan areas	-0.978	-9.73	-0.712	-9.30	-1.007	-8.16
Region (Hokkaido)	0.226	5.19	0.214	4.47	0.249	3.70
Region (Chugoku)	0.251	6.05	0.332	6.46	0.294	4.32
Region (Kyushu)	0.202	4.78	0.181	4.14	0.195	3.00
City w >1M pop.	**-0.149**	**-1.54**	**-0.153**	**-1.60**	**-0.446**	**-3.96**
City w <0.1M pop.	0.381	2.37	0.577	3.72	0.292	1.78

Negative effect of City w >1M pop. increased

Estimation results (cont.)

	1990		2000		2005	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Disposal income	0.316	4.92	0.203	4.12	0.249	3.59
Expense for recreation	0.025	0.37	-0.012	-0.04	0.014	0.10
Discretionary activity	0.016	**3.51**	0.011	**2.15**	-0.008	**-1.10**
Housekeeping time	0.002	0.20	0.007	0.65	0.020	1.24
Travel time	0.046	4.94	0.071	5.53	0.039	2.36
#PC	0.127	0.86	0.034	0.64	0.073	0.97
#TV	0.940	7.39	0.359	5.33	0.335	4.08
#audio player	0.357	6.07	0.182	3.21	0.016	0.17

- Coefficient of Income fluctuated
- Positive correlation of discretionary activity disappeared
- Trade-off between PC, TV, audio player is not found

Marginal effect of income

Coeffient estimate is multiplied by scale parameter as a proxy of elasticity

	1990		2000		2005	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Disposal income	0.316	0.06	0.203	0.05	0.249	0.07

	1990		2000		2005	
	Est.	s.e.	Est.	s.e.	Est.	s.e.
$1/\sigma$ (IE)	0.610	0.06	0.939	0.09	0.689	0.07

	1990	2000	2005
Disposal income * $1/\sigma$	0.193	0.191	0.172

# Effect of disposal income on probability decreased

Conclusions

On three potential factors

- Convenience of transit at metropolitan areas
  - Consistent with data for one-person household
  - Effect of larger cities increased in the model

- Financial constraint
  - Not significant
  - Effect of income decreased

- Diversification of hobby
  - Supported by data
  - Positive correlation of discretionary activity disappeared in the model
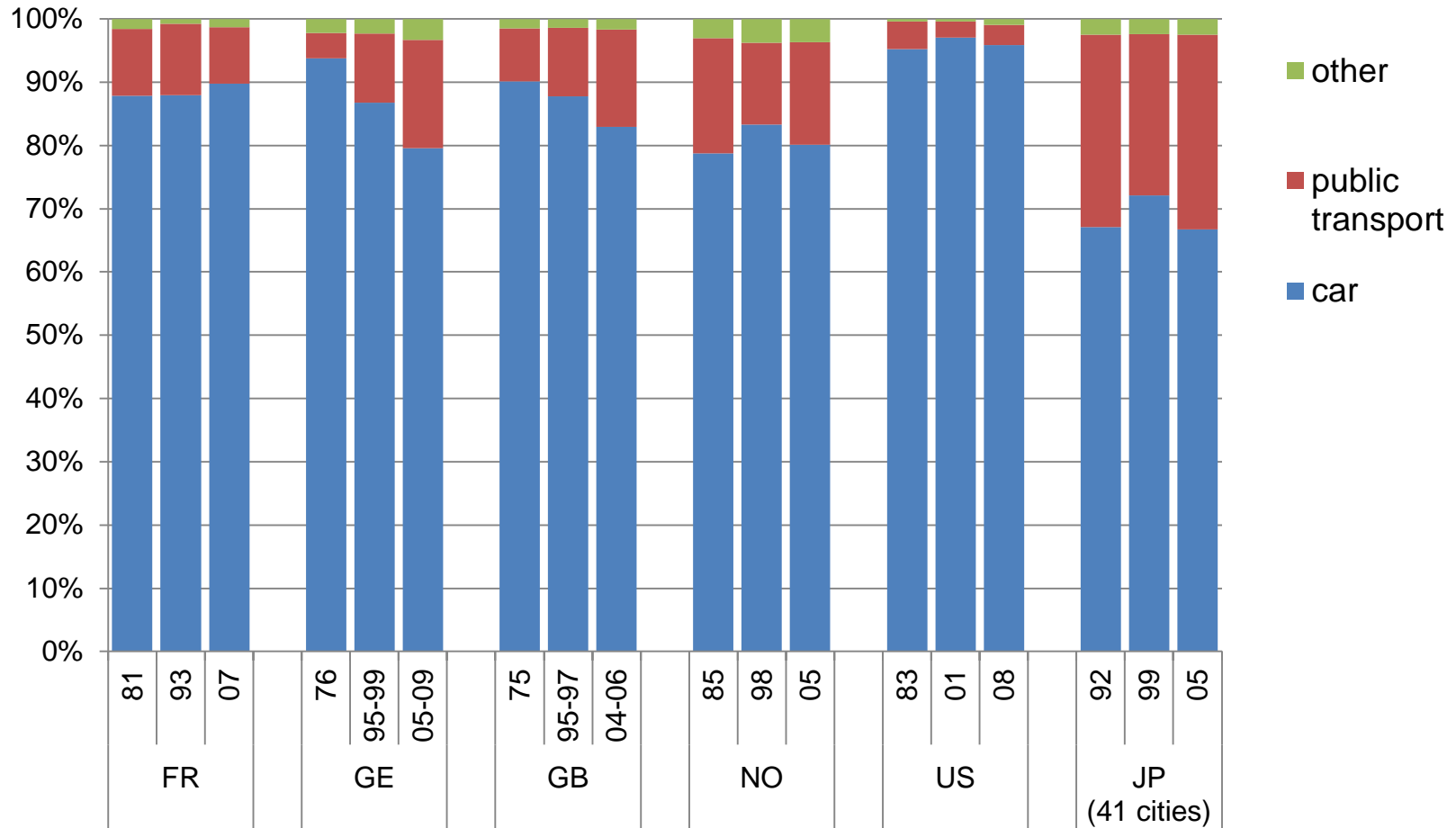
Appendix

Modal split
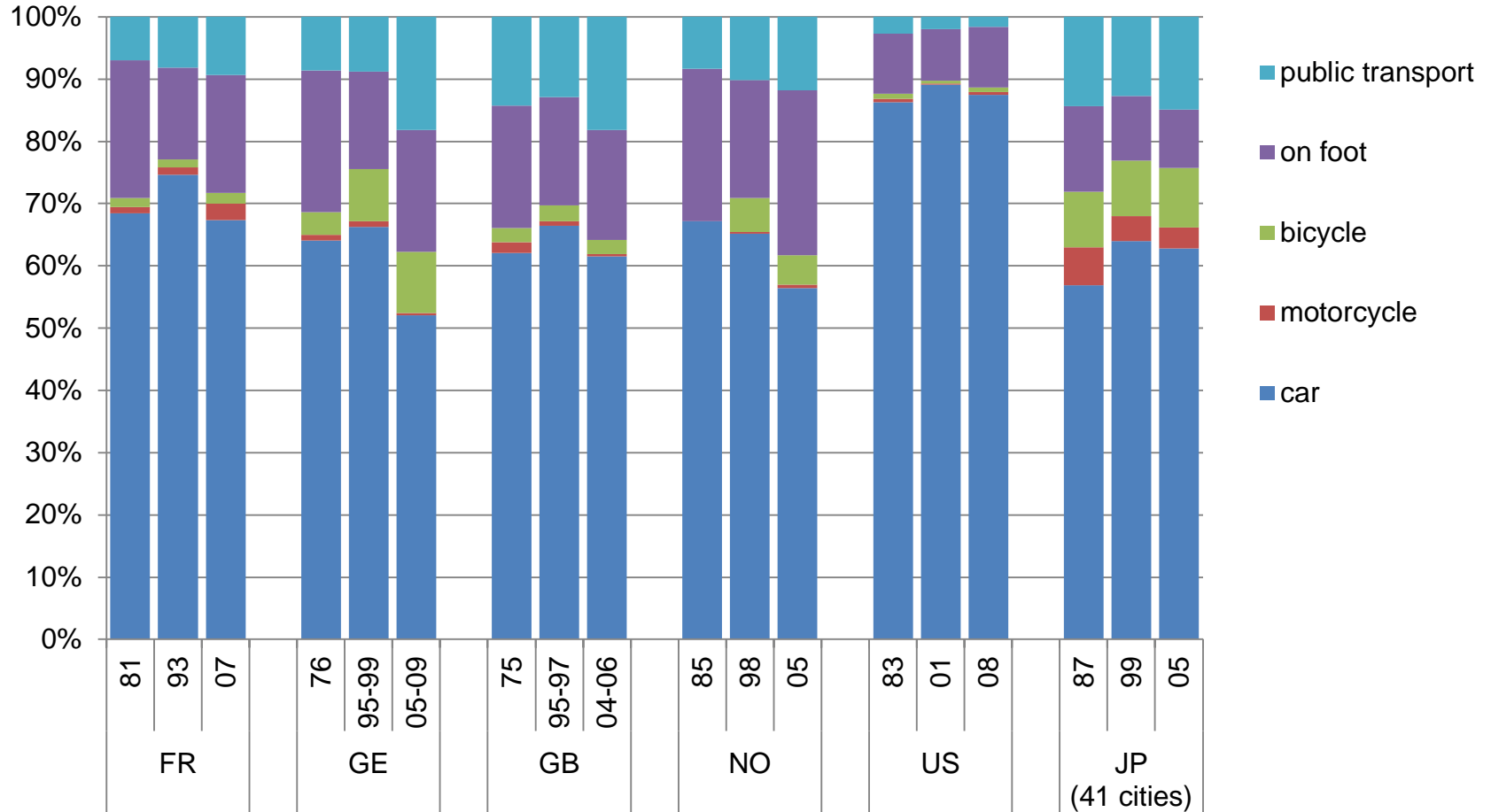
- Car dominant in USA
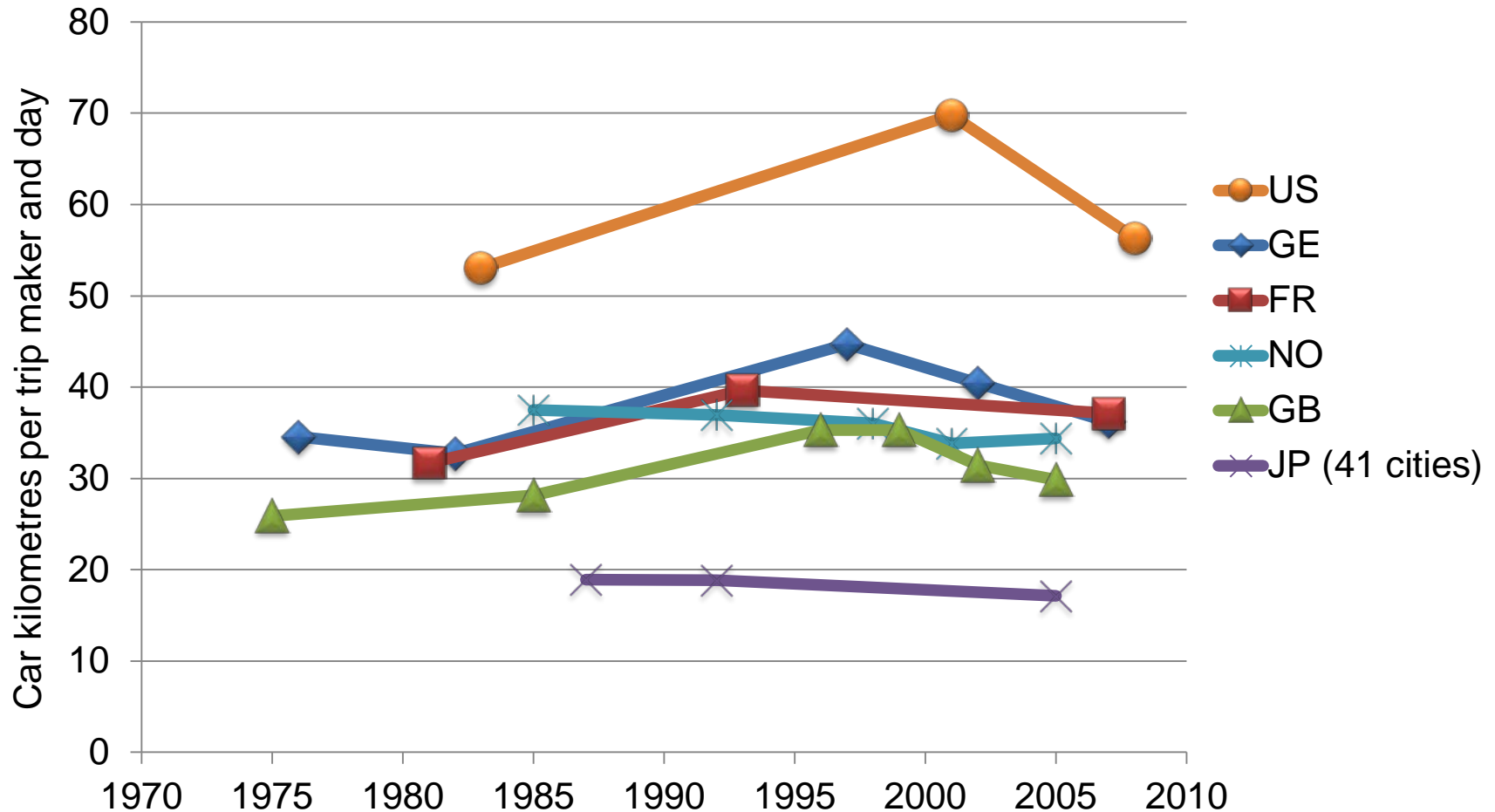- Car share has declined recently except Japan

Multimodality

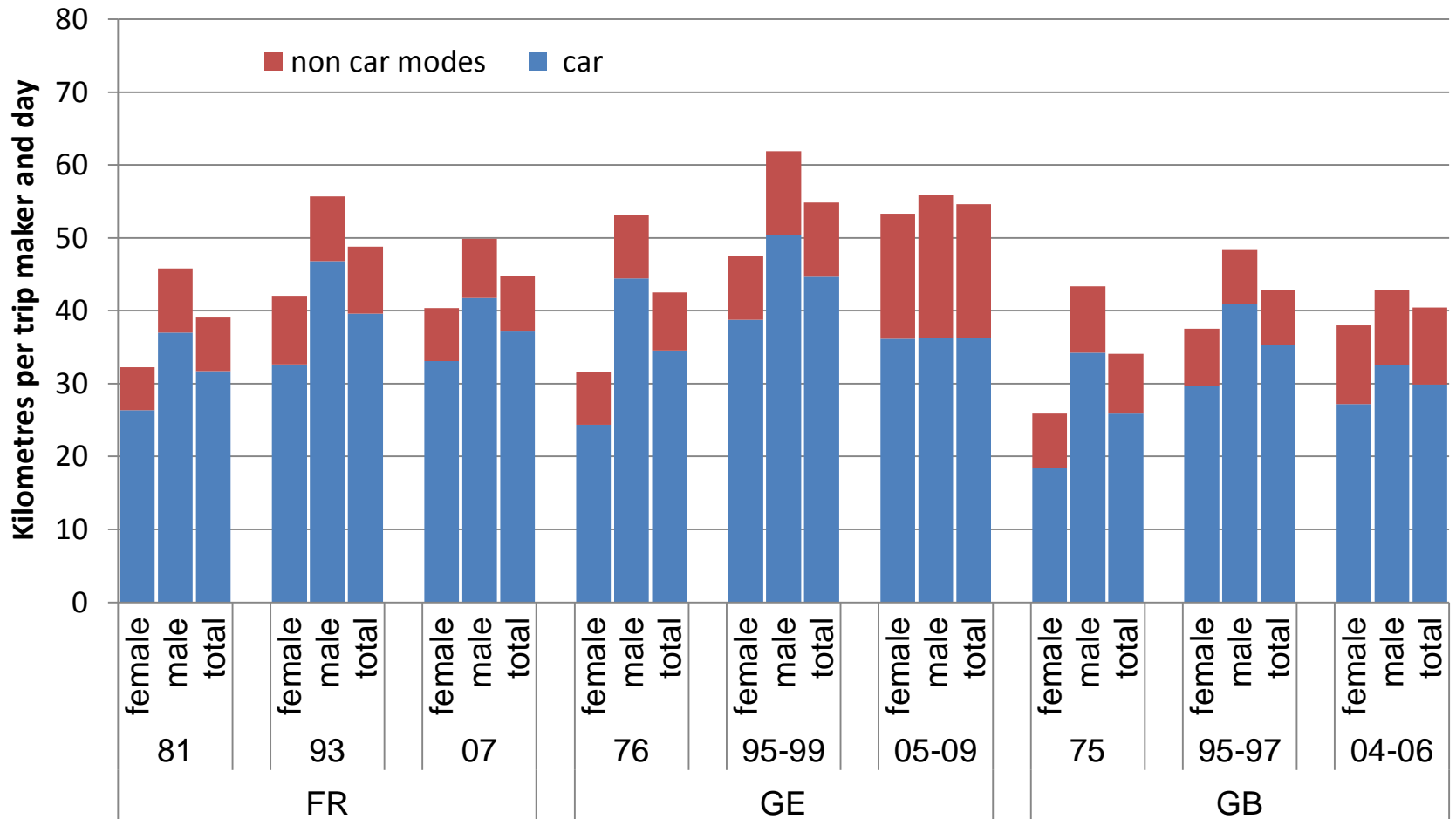- Share of mileage by those with car availability

- No multimodality in USA
- High multimodality in Japan (partly by survey area)

Car mileage

- Low in Japan (partly by survey area)
- Germany & Great Britain peaked in late 1990s
- Decline in 2008 for USA (high fuel price & economic crisis)

Car mileage & total mileage by gender

- Men reduced car mileage more strongly than women
- Only German shifted to alternative modes significantly

Car mileage & total mileage by gender
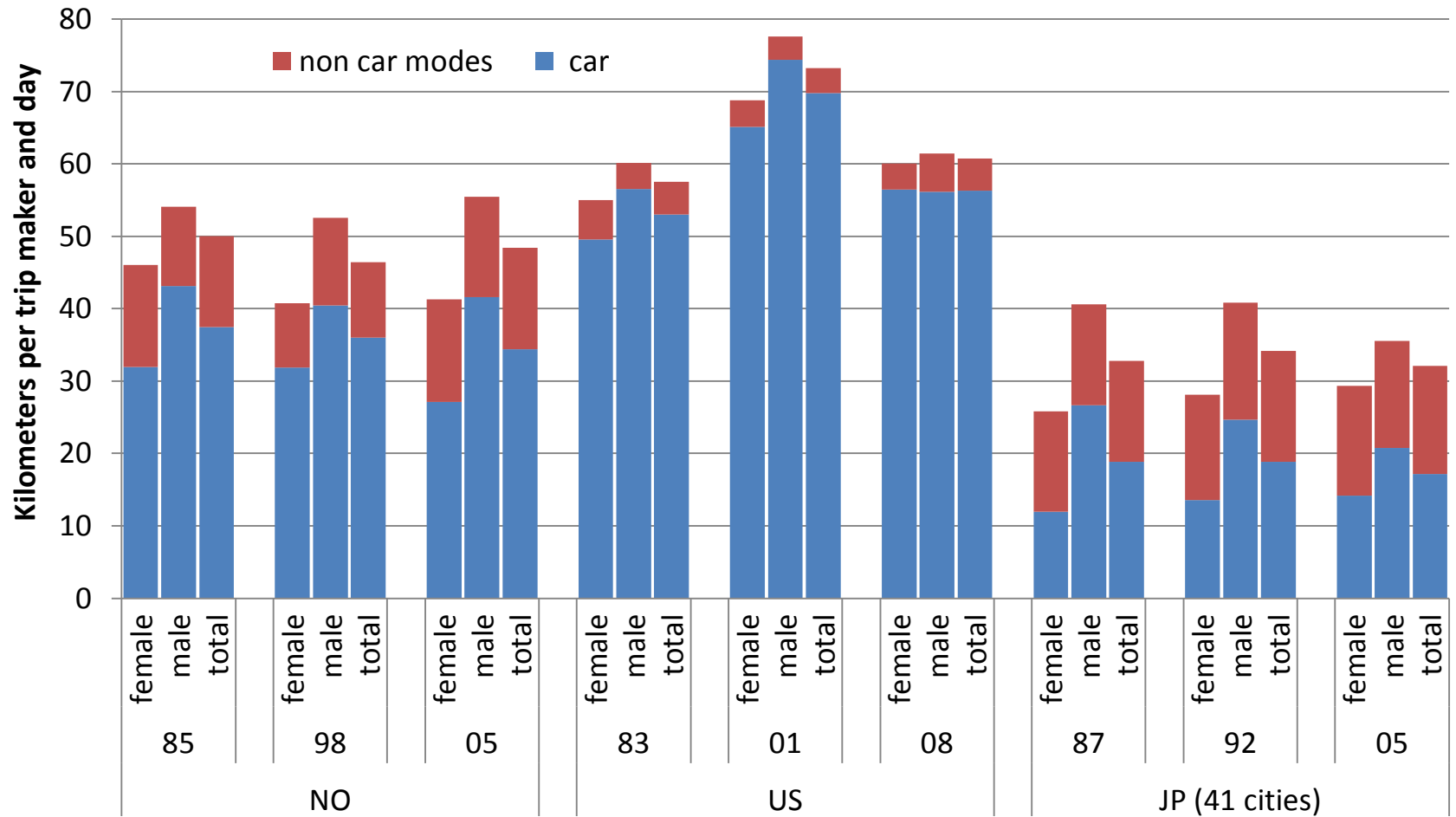
- Gender gap has narrowed significantly except Norway
- Car mileage of women continued to grow in France & Japan

Potential factors (Kuhnimhof et al. 2012)

- Socio-economic changes
  - Increasing share of receiving tertiary education
  - Decreasing workforce participation
  - Increasing age for starting a family
  - Increasing share of urban population
- Factors with possible impacts
  - Policy measures discouraging driving
  - Developments in long-distance travel (LCC air & high speed rail)
  - Psychological factors: environmental awareness and pragmatism in mobility choice
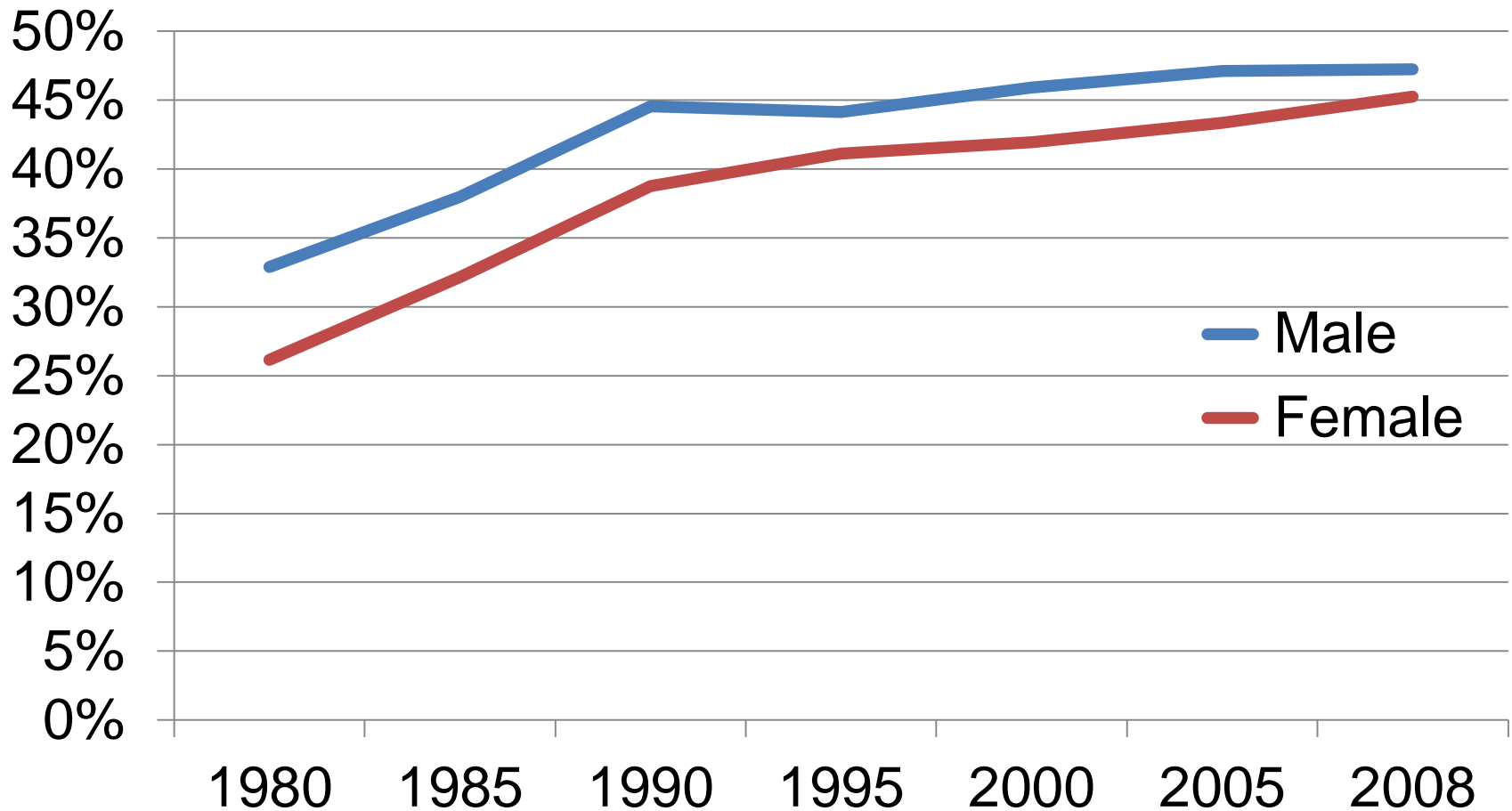 - Impact of ICT

Potential factors (Goodwin, 2012)

- Traditional 'economic' factors of prices and incomes
- Changes to the relative quality and reliability of travel
- Developments in land use planning
- New social/technical patterns and preferences seen as influences on behavior
- New patterns of work, shopping, entertainment and leisure
- Direct and indirect effects of technologies providing mobile internet access

Potential factors (Delbosc & Currie, 2013)

- Life stage
- Affordability
- Location and Transport
- Driver licensing regulations
- Attitudes
- E-communication

Share of unmarried people living with their parents (20 to 34 years old)

- Access to cars of parents?