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Detangling the impacts of age, residential locations and household lifecycle in car use and ownership in the Osaka Metropolitan Area, Japan

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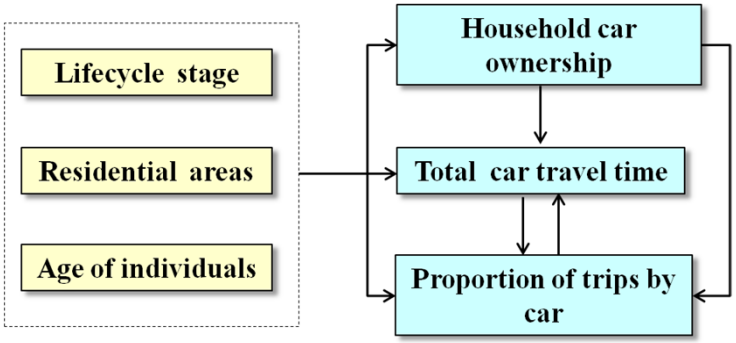
Study Objective

To explore how much of the change in urban residents' auto travel is due to changes in demographics and how much is due to structural change.

Method



$$
\begin{cases}
\begin{cases} Y_{AO} = \begin{cases} Y_{AO}^{*} & if\ Y_{AO} > 0 \\ 0 & otherwise \end{cases} \\ Y_{AO}^{*} = \beta_0 + \beta_{AO,LC} X_{LC} + \beta_{AO,RA} X_{RA} + \beta_{AO,A} X_A + \varepsilon_{AO} \end{cases} \\
\begin{cases} Y_{AT} = \begin{cases} Y_{AT}^{*} & if\ Y_{AT} > 0 \\ 0 & otherwise \end{cases} \\ Y_{AT}^{*} = \beta_0 + \beta_{AT,LC} X_{LC} + \beta_{AT,RA} X_{RA} + \beta_{AT,A} X_A + \gamma_{AT,AO} \hat{Y}_{AO} + \gamma_{AT,FA} \hat{Y}_{FA} + \varepsilon_{AT} \end{cases} \\
\begin{cases} Y_{FA} = \begin{cases} Y_{FA}^{*} & if\ Y_{FA} > 0 \\ 0 & otherwise \end{cases} \\ Y_{FA}^{*} = \beta_0 + \beta_{FA,LC} X_{LC} + \beta_{FA,RA} X_{RA} + \beta_{FA,A} X_A + \gamma_{FA,AO} \hat{Y}_{AO} + \gamma_{FA,AT} \hat{Y}_{AT} + \varepsilon_{FA} \end{cases}
\end{cases}
$$

Results

(a) Automobility characteristics

Data (y)	Coefficient vector (y')					
	Y_{AO}		Y_{AT}		Y_{FA}	
	1970	2000	1970	2000	1970	2000
1970	0.47	1.56	11.56	15.19	0.10	0.13
2000	0.40	1.32	9.60	15.58	0.09	0.12

For each of the automobility characteristics variables (Y_{AO}, Y_{AT}, Y_{FA}), its mean value, with the data from year y and the coefficient vector from year y', is shown in the cell corresponding y, y'.

(a) Change in automobility characteristics due to change in explanatory variable values (value with 1970 data = 100)

Data (y)	Coefficient vector (y')					
	Y_{AO}		Y_{AT}		Y_{FA}	
	1970	2000	1970	2000	1970	2000
1970	100	100	100	100	100	100
2000	85.11	84.62	83.04	102.57	90	92.31

(a) Change in automobility characteristics due to change in coefficient vector (value with 1970 coefficient vector = 100)

Data (y)	Coefficient vector (y')					
	Y_{AO}		Y_{AT}		Y_{FA}	
	1970	2000	1970	2000	1970	2000
1970	100	331.91	100	131.40	100	130
2000	100	330	100	162.29	100	133.33

Conclusions

- **The statistical analyses have offered strong evidence that urban residents' auto use have been expanding.**

- **The results have further indicated that this expansion has been caused primarily by changes in the structural relationships even mixed changes in demographic factors have had opposite, cancelling effects on auto travel.**

- **The resultant model system is applied in a scenario analysis to forecast possible changes in future auto travel that will follow hypothetical demographic changes in the metropolitan area.**