Commuting paradox revisited - Compensation for commutes in two-earner households?

Konferenz "Verkehrsökonomik und -politik" 2017

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June 29, 2017

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Motivation I

Commuting in Germany

- Since 2005 commuting time, distance and modal split are relatively constant [Wingerter (2014)]
- German employees commute longer than the EU average [EU (2015)]

Commuting is a disutility

- Kahneman et al. (2004) - Day Reconstruction Method (DRM) - instrument that reconstructs the emotions of a day - commuting is associated with the lowest level of positive affects among all daily activities
- Stone et al. (2006) - confirm findings - commuting is negative significant to the emotion "enjoyment"

Motivation II

Table 3
Results of Multilevel Analysis of Time of Day and Activities on Enjoyment, Frustration, and Tired (n = 909)

	Frustration		
Activities	Enjoyment	Beta	Tired
a. Commuting	−.35***	.30***	−.04
b. Working	−.20***	.32***	−.08
c. Shopping	.15	.08	−.14
d. Preparing food	.00	.04	.04
e. Doing housework	−.60***	.22***	.17**
f. Taking care of children	−.02	.37***	.14*
g. Eating	.45***	−.39***	−.16***
h. Praying/worship	.38***	−.26**	.02
i. Socializing	.71***	−.41***	−.44***
j. Watching TV	.32***	−.20***	.05
k. Nap/resting	.30***	−.23**	.76***
l. Computer/internet	−.02	−.03	−.03
m. Relaxing	.57***	−.35***	.05
n. On phone	−.08	.25***	.05
o. Intimate relations	.82***	−.34*	−.55***
p. Exercising	.73***	−.55***	−.39**

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure: Stone et al. (2006:145)

Motivation III

Stutzer&Frey (2008) - commuting paradox I

- Monocentric city model [Alonso (1964), Mills (1972)]
- Individuals only commute if they are compensated either by higher income or lower rents
- They choose the optimal commuting time in order to maximize their utility

$$
\begin{aligned}
U =& u(y, D, r) = \bar{U} \\
dU =& \frac{\partial u}{\partial y} dy + \frac{\partial u}{\partial D} dD + \frac{\partial u}{\partial r} dr \quad = 0 \\
\frac{dU}{dD} =& \frac{\partial u}{\partial y} \frac{dy}{dD} + \frac{\partial u}{\partial D} + \frac{\partial u}{\partial r} \frac{dr}{dD} \quad = 0
\end{aligned}
\tag{1}
$$

Motivation IV

Stutzer&Frey (2008) - commuting paradox II

$$u_i = \alpha_i + \beta D_i + \varepsilon_i \tag{2}$$

- If Individuals are fully compensated, than $\partial U / \partial D_i = 0$ and $\beta = 0$
- Stutzer&Frey (2008) estimate fixed effects model
- Result: $\beta \neq 0$ significantly
- Individuals with longer commutes report systematically lower utility

Aim of this research

- Does the commuting paradox still holds when taking household effects into account?
- How do households decide on commuting? Jointly or individually wrt spouse?

Literature review I

Commuting in General

1. urban economics
   - Monocentric city model [Alonso (1964), Mills (1972)]
   - Residential location choice to maximize utility
   - Empirical results show actual commutes are much longer than predicted in the US - wasteful commuting [e.g. Small&Song (1974)]
2. labor economics
   - Commuting is a source of labor mobility
   - Commuting is contained into models of job search [Rouwendal (2004); Van Ommeren et al. (2000); etc.]
   - Main interest: willingness to pay for commuting

Critical remark: Endogenous relationship between location choices and commuting

Literature review II

Relationship between commuting and utility

1. Roberts et al. (2011)
   - Introducing gender differences to commuting paradox
   - Commuting has an strong negative effect on psychological health only on women, not on men
2. Stutzer & Frey (2014)
   - Do individuals mispredict future utility concerning commuting and income
   - Individuals adapt to higher labor income but not to commuting
3. Dickerson et al. (2014)
   - Discusses the methodology of estimating the relationship of utility and commuting
   - Find no empirical evidence for commuting paradox

Theoretical identification I

How to implement household effects into utility function?

2 microeconomic household models considered

- Maximizing jointly household's utility
- Maximizing individual's utility given the commuting behavior of the spouse

Theoretical identification II - Household utility model

Maximizing jointly household utility

Madden (1980) and Singell&Lillydahl (1986) in urban context

$$\text{max} \quad u_h = \sum_i u_i = u(D_i, H) = \bar{u}_h \qquad i = m, f \tag{3}$$

$$h = \text{household}$$

Monetary and time budget constraint

$$\text{s.t.} \qquad rH + \sum_i c_i D_i = \sum_i (w_i L_i + \Delta w_i D_i) \tag{4}$$

$$T = L_i + t_i D_i$$

FOC

$$\frac{\partial L}{\partial D_i} = \frac{\partial u_i}{\partial D_i} - \lambda_i (c_i + \Delta w_i) - \mu t_i \stackrel{!}{=} 0 \tag{5}$$

$$\frac{\partial L}{\partial H} = \sum_i \frac{\partial u_i}{\partial H} - \lambda r \stackrel{!}{=} 0 \tag{6}$$

Theoretical identification II - Household utility model

$$\frac{\partial u_i / \partial D_i}{\sum_i \partial u_i / \partial H} = \frac{c_i + \frac{\mu}{\lambda} t_i - \Delta w_i}{r} \tag{7}$$

.

Hypotheses of household utility model

- $\sum \frac{\partial u_i}{\partial D_i} = 0 \rightarrow \beta_{D_i} + \beta_{D_j} = 0$ iff household is jointly compensated

Theoretical identification III - Individual utility model

Maximizing individual utility w/ given partner's behavior

Manser&Brown (1980)

$$\max \quad u_i = u(D_i, H) \qquad i = m, f \tag{8}$$

Monetary and time budget constraint

$$\begin{aligned} \text{s.t.} \qquad & rH + c_i D_i = (w_i L_i + \Delta w_i D_i) \\ & T = L_i + t_i D_i \\ & u_j(D_j, H) \geq \bar{u}_j \end{aligned} \tag{9}$$

FOCs

$$\frac{\partial L}{\partial D_i} = \frac{\partial u_i}{\partial D_i} - \lambda_i (c_i + \Delta w_i) - \mu t_i \stackrel{!}{=} 0 \tag{10}$$

$$\frac{\partial L}{\partial H} = \frac{\partial u_i}{\partial H} + \gamma_i \frac{\partial u_j}{\partial H} - \lambda r \stackrel{!}{=} 0 \tag{11}$$

Theoretical identification III - Individual utility model

MRS

$$\frac{\partial u_i/\partial D_i}{\partial u_i/\partial H + \gamma_i \partial u_j/\partial H} = \frac{c_i + \frac{\mu}{\lambda} t_i - \Delta w_i}{r} \tag{12}$$

.

Hypotheses of individual utility model

1. If spouse i is not fully compensated $(\partial u_i/\partial D_i < 0)$
   - $\beta_{D_i} < 0$ for D_i of spouse i
   - $\beta_{D_j} \overset{?}{>\!<} 0$ for D_j of spouse j
2. If spouse i is fully compensated $(\partial u_i/\partial D_i = 0)$
   - $\beta_{D_i} = 0$ for D_i of spouse i
   - $\beta_{D_j} > 0$ for D_i of spouses j (overcompensated by r)

Empirical identification - Estimation model

Household utility model

$$u_{ht} = \sum_i u_{it} = \beta_1 log(D_{it}) + \beta_2 (logD_{it})^2 + \beta_3 log(D_{jt}) + \beta_4 (logD_{it})^2 + \theta X_{ht} + \gamma_t + \alpha_h + \varepsilon_{ht} \quad (13)$$

Individual utility model

$$u_{it} = \beta_1 log(D_{it}) + \beta_2 (logD_{it})^2 + \beta_3 log(D_{jt}) + \beta_4 (logD_{it})^2 + \theta X_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \quad (14)$$

Squared D_{it} is normalized to yearly average commuting [Layard et al. (2008)]

Empirical identification - Econometric issues I

How to handle the dependent variable **utility**?

- **Subjective well-being (SWB)**
- As a **cardinal variable**: linear fe model
- As a **ordinal variable**: ordered logit model $\rightarrow$ fe?

Latent variable model

$$y_{it}^* = x_{it}'\beta + \alpha_i + \varepsilon_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{15}$$

$$y_{it} = k \text{ if } \mu_k < y_{it}^* < \mu_{k+1} \qquad k = 1, ..., K \tag{16}$$

- Cutoffs are assumed to be strictly increasing
- ε_{it} iid logistic

Empirical identification - Econometric issues II

2 Problems with ML when including fe in estimated model

- Identification of $\alpha_{ik} = \mu_k - \alpha_i$
- Incidental parameter problem [Greene (2004)]
  - Too many incidental parameter α_{ik} for fixed T [Neyman & Scott (1948)]
  - ML estimator not consistently
- **BUC** (Blow up and Cluster) - Estimator [Baetschman et al. (2011)]
  - Creating dataset where each i is repeated $K-1$ times with each different cutoffs
  - Dep. variable collapses to binary variable (Chamberlain's estimator)
  - Conditional logit with expanded dataset

Data - GSOEP

- The German Socio-Economic Panel Study (GSOEP)
- Representative longitudinal study of private households in Germany since 1984
- Subjective and economic, demographical information of Individuals
- $\sim$ 11.000 households and $\sim$ 20.000 individuals every year

Data - Sample selection

- 2009 - 2013 (balanced panel)
- **dual-earner households**
- age 18-65
- employed (no self-employed, no home worker, no on-the-job training)
- commuter with same work location
- $\sim$ 20.000 obs and $\sim$ 5.000 individuals
- **Controls**: fulltime, edu, tenure, age, married, child, ownership, female, homework

Data - Descriptives I

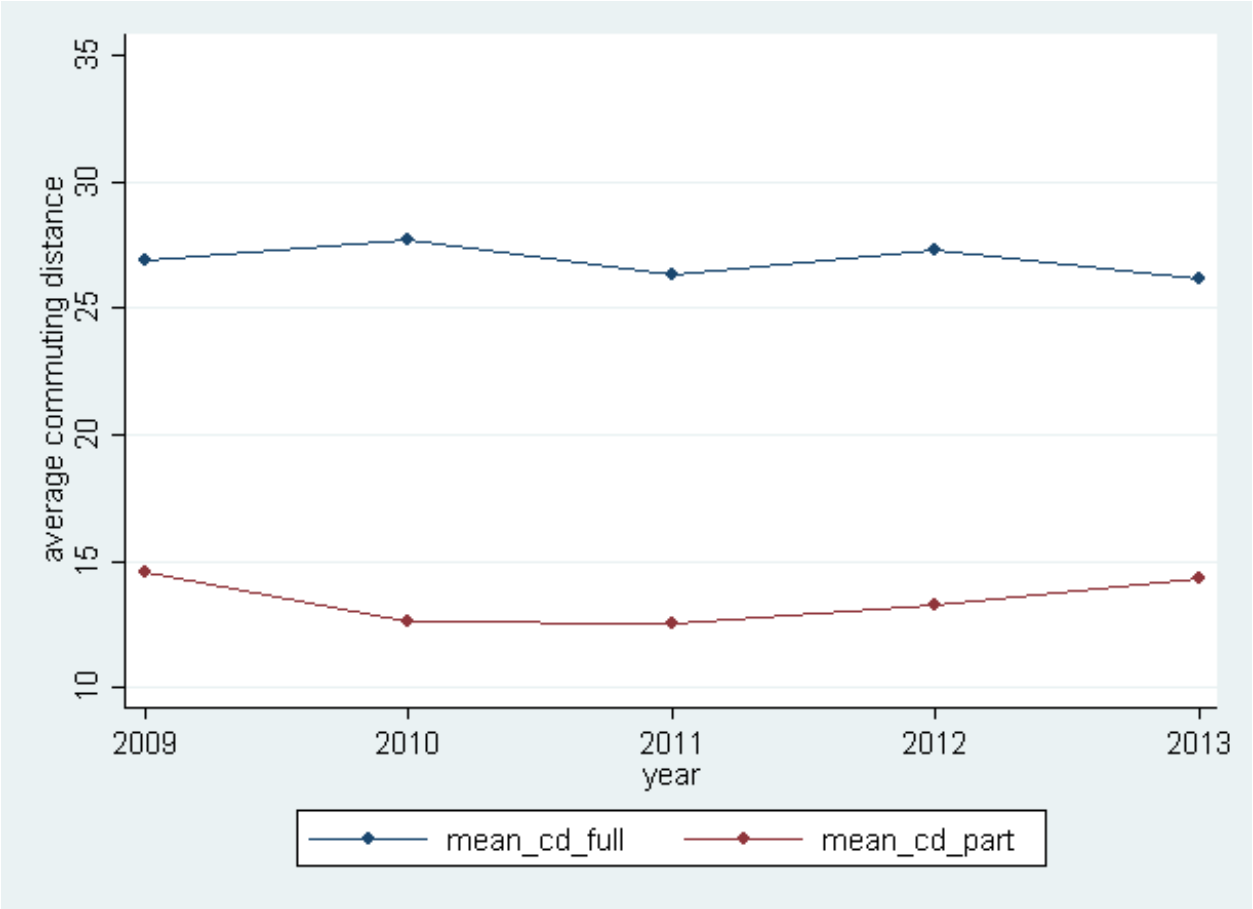

Figure: Average Commuting Distance and work length differences

Data - Descriptives II

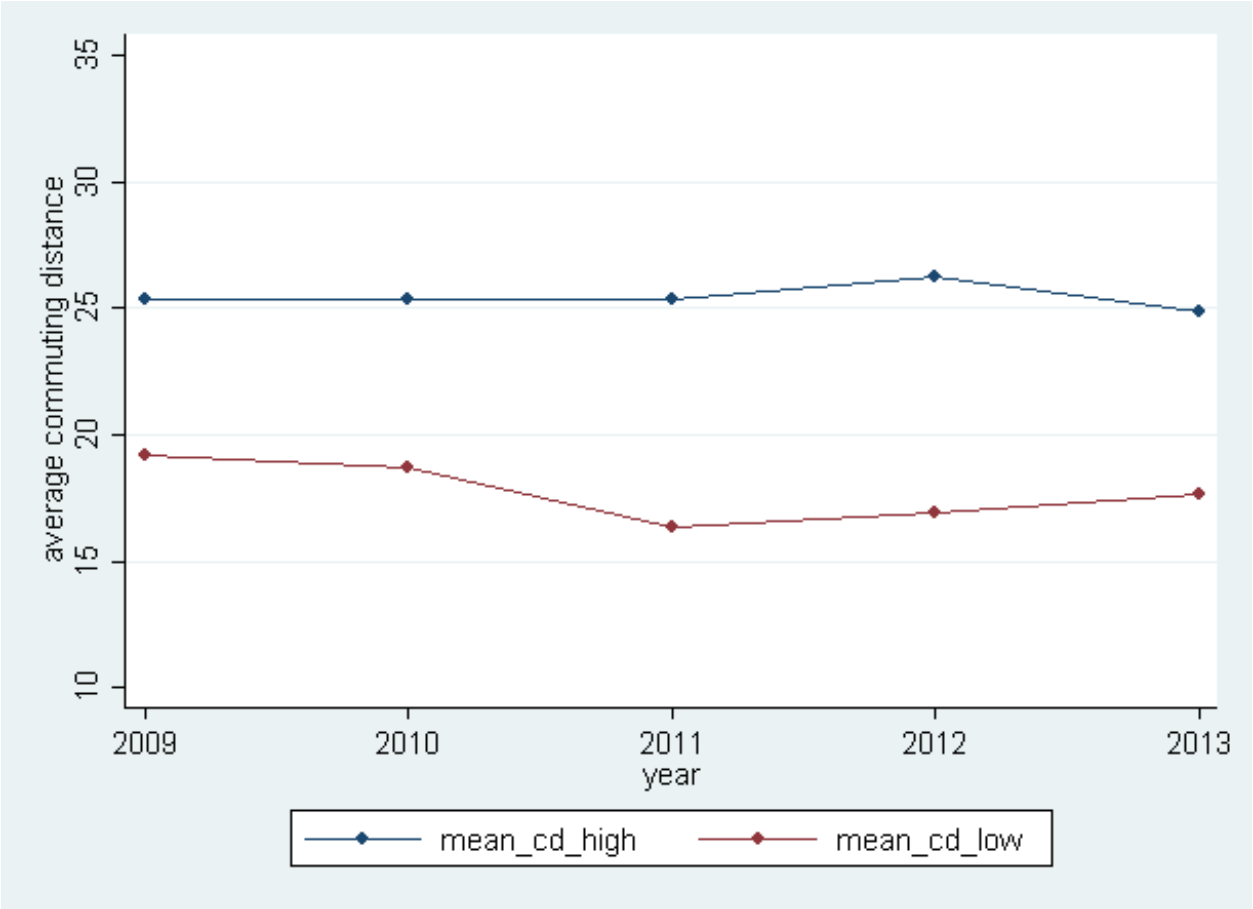

Figure: Average Commuting Distance and income differences

Data - Descriptives III

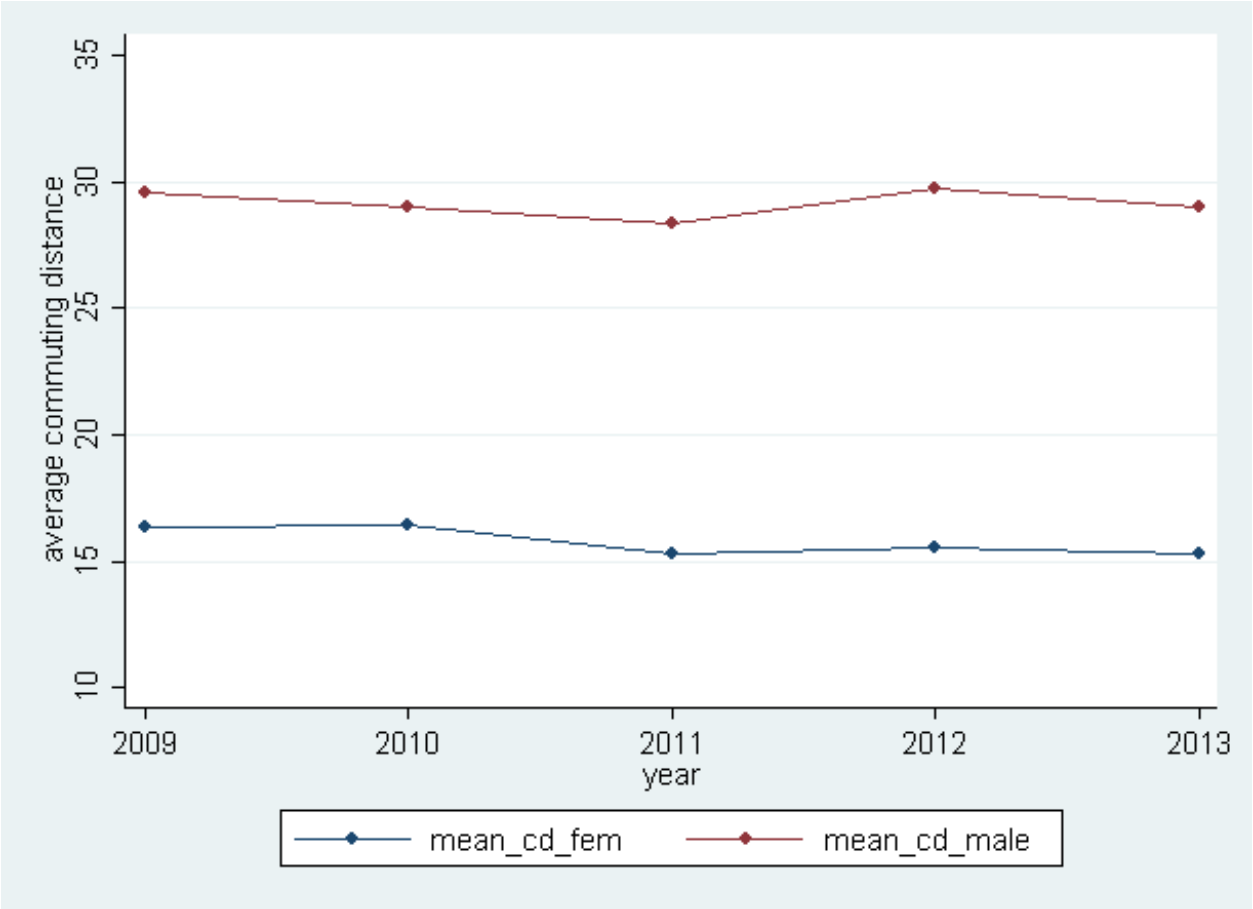

Figure: Average Commuting Distance and gender differences

Results I - Household utility model

Relationship of household SWB and both commuting distances

	pooled_OLS	**OLS_fe**	**OL_pooled**	**OL_re**	**OL_fe (BUC)**
D_i	-0.106***	-0.123	-0.071***	-0.147**	-0.134
	(0.031)	(0.065)	(0.021)	(0.049)	(0.089)
D_i^2	-0.008	-0.018	-0.008	-0.027	-0.032
	(0.017)	(0.028)	(0.012)	(0.026)	(0.036)
D_j	-0.013	0.032	0.005	0.003	0.025
	(0.040)	(0.064)	(0.028)	(0.056)	(0.097)
D_j^2	-0.006	-0.030	0.003	-0.022	-0.046
	(0.019)	(0.029)	(0.014)	(0.027)	(0.043)
Controls	✓	✓	✓	✓	✓
time dummies	✓	✓	✓	✓	
F-Test	6.88 (0.000)	3.95 (0.000)			
households		2151		2151	1488
Obs	6812	6812	6812	6812	16716

Dependent Variable: life satisfaction (sum of ind. SWB)
Controls: married, child, ownership
Standard errors in parentheses.
*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Results II - Individual utility model

High income spouse SWB wrt partner commuting behavior

	OLS_pooled	**OLS_fe**	**OL_pooled**	**OL_re**	**OL_fe (BUC)**
D_i	-0.070***	-0.056	-0.087***	-0.172***	-0.097
	(0.019)	(0.038)	(0.023)	(0.050)	(0.099)
D_i^2	0.006	0.004	-0.001	-0.001	0.000
	(0.010)	(0.018)	(0.012)	(0.026)	(0.045)
D_j	-0.008	-0.039	0.004	-0.032	-0.106
	(0.023)	(0.041)	(0.029)	(0.058)	(0.104)
D_j^2	0.004	-0.022	0.009	-0.008	-0.056
	(0.011)	(0.018)	(0.014)	(0.027)	(0.049)
Controls	✓	✓	✓	✓	✓
Time dummies	✓		✓	✓	
Individuals		2098		2098	1291
Obs	6541	6541	6541	6541	9560

Dependent Variable: life satisfaction (ind. SWB)
Controls: fulltime, edu, tenure, age, married, child, female, housework, owner
Standard errors in parentheses.
*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Results III - Individual utility model

Low income spouse SWB wrt partner commuting behavior

	OLS_pooled	**OLS_fe**	**OL_pooled**	**OL_re**	**OL_fe (BUC)**
D_i	-0.042	0.058	-0.049	-0.056	0.107
	(0.024)	(0.045)	(0.029)	(0.055)	(0.111)
D_i^2	-0.011	-0.009	-0.007	-0.024	-0.027
	(0.012)	(0.020)	(0.014)	(0.026)	(0.045)
D_j	-0.065***	-0.031	-0.082***	-0.105*	-0.081
	(0.019)	(0.041)	(0.022)	(0.046)	(0.082)
D_j^2	-0.015	-0.033	-0.018	-0.040	-0.529
	(0.010)	(0.020)	(0.012)	(0.024)	(0.035)
Controls	✓	✓	✓	✓	✓
Time dummies	✓		✓	✓	
Individuals		2100		2100	1363
Obs	6614	6614	6614	6614	10645

Dependent Variable: life satisfaction (ind. SWB)
Controls: fulltime, edu, tenure, age, married, child, female, housework, owner
Standard errors in parentheses.
*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Robustness

- Is commuting truly exogenous? - sub samples w/ no location changes
- CT instead CD - only 3 time periods (1995-1999-2003)
- Balanced /unbalanced - larger sample, no significantly changes
- Makro data included - local labor market condition influence commuting behavior

Conclusion

- Taking 2 microeconomic household theories into account (Maximizing household utility vs. maximizing individual utility)
- Commuting paradox hypotheses of Stutzer & Frey (2008) does not hold for two-earner households
- Empirical evidence for hypothesis of maximizing jointly household utility
  - Commuting decisions are household decisions!
  - No empirical evidence for individual commuting decision making process

Thank you!

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