EPFL - Lausanne

22-23 June 2017

Habitual latent behaviour and dynamic effect of inertia

Elisabetta Cherchi

Taha Rashidi
Maria Börjesson
Michel Bierlaire

Outline

- Background
- Objective
- The theoretical model
- Modelling results & some policy implication
- Conclusions

Background

The influence of habit/inertia in the choice process is a well known problem.

Still, many different methods are used to account for inertia.

There is not a unique "accepted" paradigm.

Habit

leads to

Inertia

related with the tendency to repeat a decision without thinking again about the reasons why we behave in such way.

related with a resistance to changing behaviour.

Many factors

- ✓ Past experience
- ✓ Risk aversion / variety seeking
- ✓ Influence of fashion and peer group norms
- ✓ Thresholds in perceptions / Limited information
- ✓ Life shocks
- ✓ … unknown effects

Background

In the psychological literature, the standard measure of habit is the frequency with which a given behaviour has been performed in the past.

- Frequency of past behaviour tends to explain most of the variance in intention (or behaviour), thus often rendering as not significant most other predictors.

In the transport literature *inertia* has been measured as the effect that preferences experienced in previous periods have on the current choice.

- Lagged variable is perhaps the most popular way to measure the effect of previous choices in the current one.

Cherchi, Meloni and Ortuzar (2013) estimated a hybrid choice model to account for habitual behaviour in the revealed preference choices.

- Habit is revealed by the frequency of past behaviour (like in the psychological literature) but frequency is only an indicator of a habitual behaviour. The true process behind the habitual behaviour is latent.

Objective

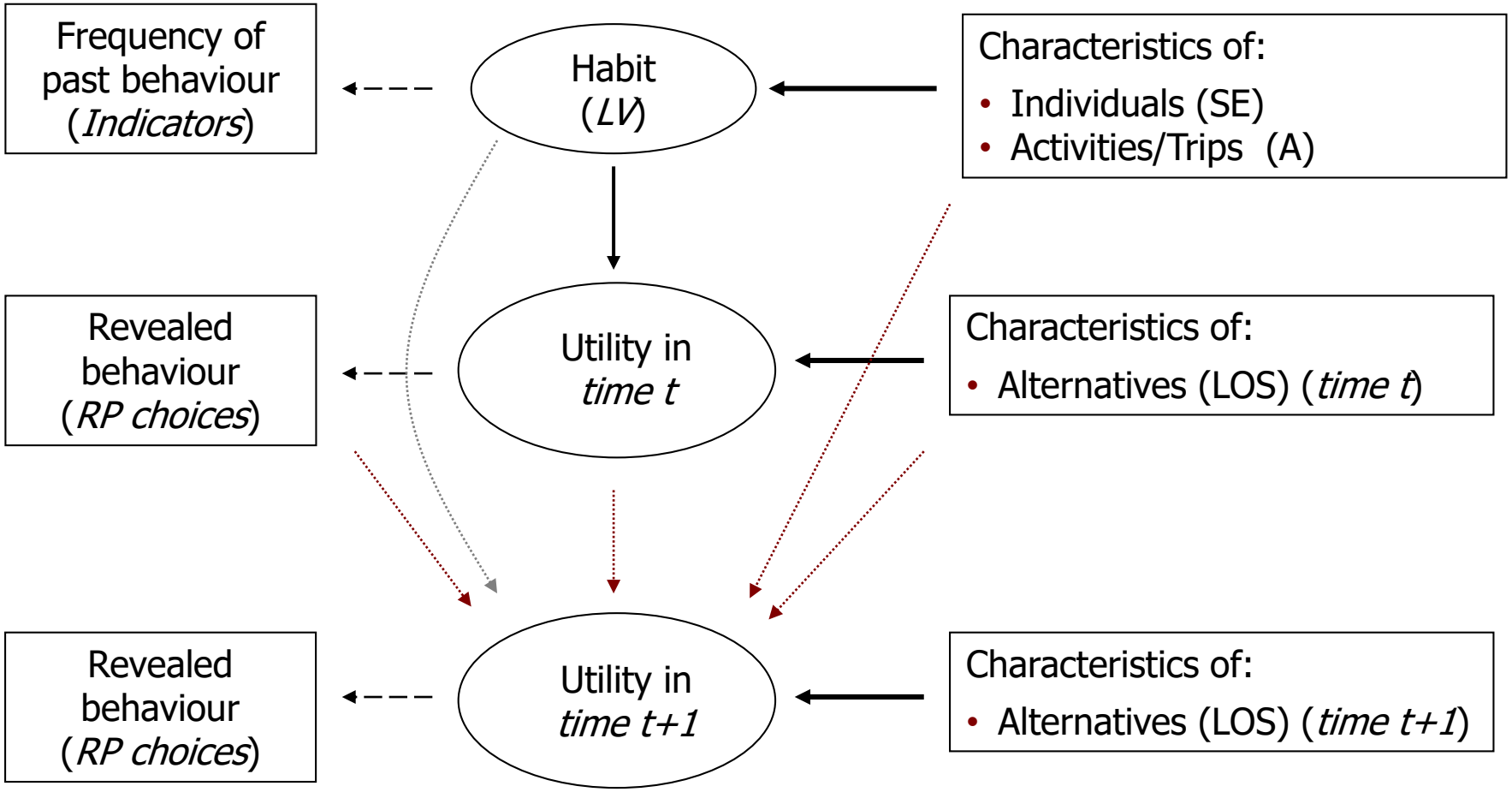
To measure the effect of inertia in the mode choice, trying to account for both effects:

- *individual propensity to undertake habitual behaviour*, measured through the latent variable.
- *tendency to stick with the same alternative*, measured through lagged variables that link the current choice with the previous trip.

Test if we can account for any dynamics in these effects, i.e. how they evolve over time (we test in a period of 6 weeks)

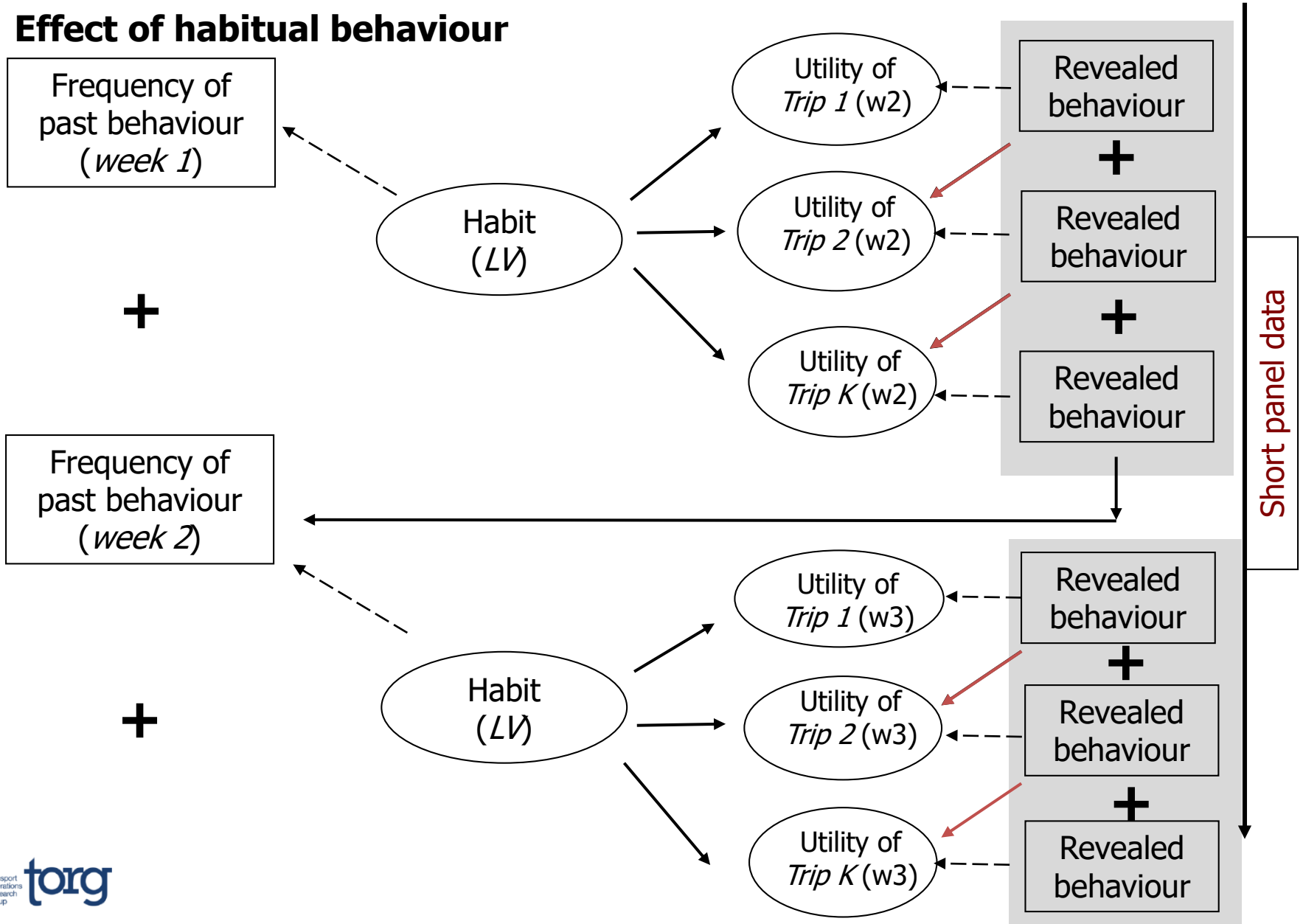
Methodology

Structure of the HCM



Methodology

Effect of habitual behaviour



Methodology

Hybrid choice model

$$U_{jqt} = f(LOS_{jqt}, SE_q, \mathrm{A}_{jqt}; \boldsymbol{\theta}_j, \boldsymbol{\lambda}_p) + \varepsilon_{jqt} +$$
$$\sum_w \beta_{LVj}^w LV_q + \beta_{lagT} i_{q\psi(r-1)} + \beta_{lagP} i_{qp(u-1)} +$$
$$i_{q\psi(r-1)} \times (\beta_{lagT} + \sum_w \beta_{LVj_T}^w LV_q) +$$
$$i_{qp(u-1)} \times (\beta_{lagP} + \sum_w \beta_{LVj_P} LV_q)$$

Lagged variables:

$i_{qp(r-1)}$ is defined with respect to the purpose. It takes value one if the mode chosen for trip t is the same as that chosen in the previous tour made with the same purpose.

$i_{q\xi(u-1)}$ is defined with respect to the time period in which the tour starts. It takes value one if the mode chosen for trip t is the same as that chosen for the previous tour made in the same time period as the trip t.

Panel data on a mode choice context

Thurgau panel data: a six-week travel diary

Final sample used to estimate our model contains:

- 16101 trips, 187 individual and 99 families

6 Waves: each week a wave

3 Time-of-week periods*:*

- peak period during week days (morning 5:45am-8:30am and evening 15:45-16:30)
- off-peak period during week days
- the weekend

4 Purposes: commuting, business, leisure, shopping.

5 Alternatives: car driver, car passenger, public transport, motorbike, slow modes.

Panel data on a mode choice context

Newcastle University
School of Civil Engineering &Geosciences

Attributes included*:*

- Travel time, Travel cost
- Walking time, Headway
- Ticket discount, Nntional season ticket (only PT)

- Time of the day: Peak period
- Fix working hours
- When the travel was planned: right now, during the day, routine
- SE characteristics (income, employment status, age, gender, car components)
- Distance, Purpose

Indicators for habitual behaviour :

The cumulative number of trips in the previous weeks

(i) starting in the same time category as the current trip

(ii) made with the same purpose as the current trip

(iii) made with the same mode as the current trip

Model results

Model with lagged effects AND with LV			Lagged effects alone			
			Purpose		Time	
			Estimates	**t-test**	**Estimates**	**t-test**
Car driver			0.559	6.61		
Car passenger			0.409	3.84	0.901	8.61
Public transport			1.340	11.27	0.324	2.59
Motorbike			0.552	1.78		
Slow modes			0.502	3.88		

Model with only lagged effects Without LV			Lagged effects alone			
			Purpose		Time	
			Estimates	**t-test**	**Estimates**	**t-test**
Car driver			0.830	14.08	0.526	9.11
Car passenger			0.346	3.70	0.713	7.77
Public transport			1.290	11.41	0.280	2.33
Motorbike			1.270	6.31	-0.132	-0.62
Slow modes			0.236	2.98	0.275	3.42

- Tendency to stick with the same alternative seems to be related mainly with the purpose of the trip, less with the time of the day.
- Time lagged effect for car driver and slow modes becomes not significant when LV is not included.

Model results

Model with lagged effect AND with LV			Lagged effects alone			
			Purpose		Time	
			Estimates	**t-test**	**Estimates**	**t-test**

Habitual behaviour affects mode choice:
- Directly (interestingly only for car driver and slow modes)
- Indirectly, reinforcing the lagged effect (mainly for the same purpose)

		LV effect alone		LV x Lagged effects			
				Purpose		Time	
		Estimates	**t-test**	**Estimates**	**t-test**	**Estimates**	**t-test**
Car driver	Week 2	0.503	4.04	0.571	3.22	0.610	5.53
	Week 3	0.274	4.40	0.346	3.11	0.460	5.45
	Week 4	0.245	4.47	0.436	4.97	0.379	6.20
	Week 5	0.204	4.33	0.109	1.75	0.327	6.36
	Week 6	0.153	3.64	0.183	3.18	0.217	4.62
Slow modes	Week 2	1.160	6.61	-0.610	-3.07		
	Week 3	0.644	5.52	-0.367	-2.78		
	Week 4	0.654	7.54	-0.402	-4.20		
	Week 5	0.360	6.24	-0.165	-2.19		
	Week 6	0.236	4.13	-0.059	-0.81		
Motorbike	Week 2			1.800	2.16		
	Week 3			0.461	1.47		
	Week 4			0.838	3.99		
	Week 5			0.460	2.43		
	Week 6			0.240	1.35		

Model results

Model with lagged effect AND with LV			Lagged effects alone			
			Purpose		Time	
			Estimates	**t-test**	**Estimates**	**t-test**
					01	8.61
					24	2.59

Habitual behaviour is not significant for:
- Car passengers, because you depend on someone else
- Public transport

		LV effect alone		LV x Lagged effects			
				Purpose		Time	
		Estimates	**t-test**	**Estimates**	**t-test**	**Estimates**	**t-test**
Car driver	Week 2	0.503	4.04	0.571	3.22	0.610	5.53
	Week 3	0.274	4.40	0.346	3.11	0.460	5.45
	Week 4	0.245	4.47	0.436	4.97	0.379	6.20
	Week 5	0.204	4.33	0.109	1.75	0.327	6.36
	Week 6	0.153	3.64	0.183	3.18	0.217	4.62
Slow modes	Week 2	1.160	6.61	-0.610	-3.07		
	Week 3	0.644	5.52	-0.367	-2.78		
	Week 4	0.654	7.54	-0.402	-4.20		
	Week 5	0.360	6.24	-0.165	-2.19		
	Week 6	0.236	4.13	-0.059	-0.81		
Motorbike	Week 2			1.800	2.16		
	Week 3			0.461	1.47		
	Week 4			0.838	3.99		
	Week 5			0.460	2.43		
	Week 6			0.240	1.35		

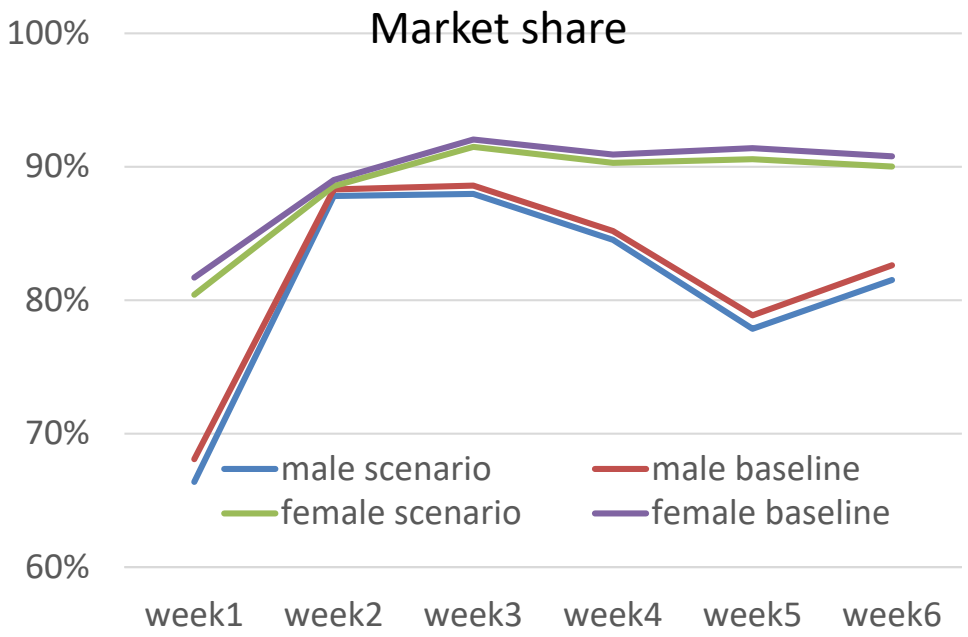
Model results

Model with lagged effect AND with LV			Lagged effects alone			
			Purpose		Time	
			Estimates	**t-test**	**Estimates**	**t-test**

The effect of habitual behaviour:
- is strong over weeks
- not always significantly different from week 3

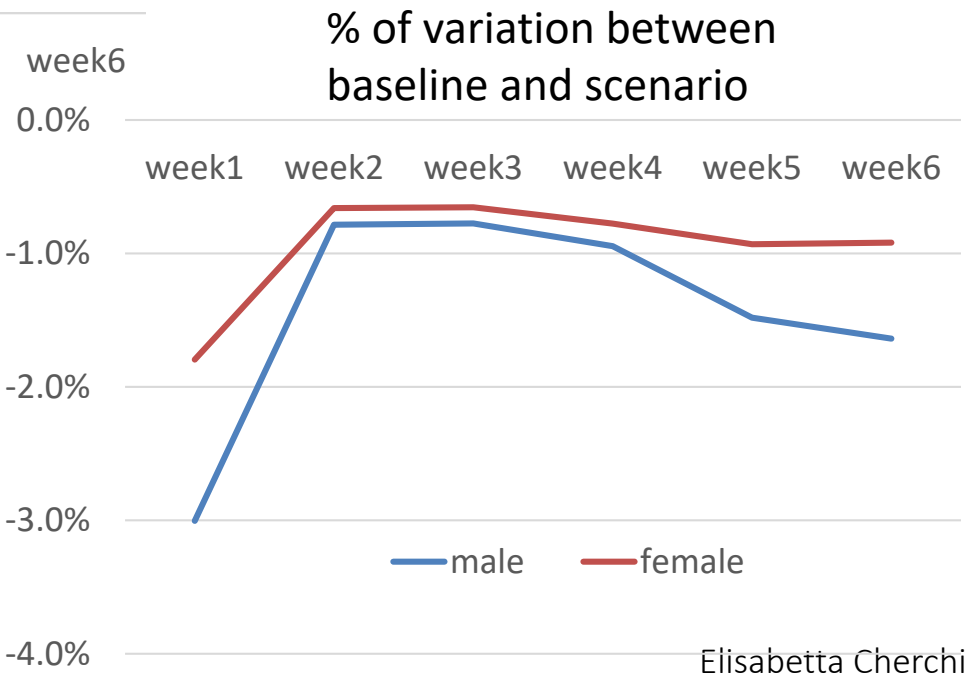
		LV effect alone		LV x Lagged effects			
				Purpose		Time	
		Estimates	**t-test**	**Estimates**	**t-test**	**Estimates**	**t-test**
Car driver	Week 2	0.503	4.04	0.571	3.22	0.610	5.53
	Week 3	0.274	4.40	0.346	3.11	0.460	5.45
	Week 4	0.245	4.47	? 0.436	4.97	0.379	6.20
	Week 5	0.204	4.33	0.109	1.75	0.327	6.36
	Week 6	0.153	3.64	0.183	3.18	0.217	4.62
Slow modes	Week 2	1.160	6.61	-0.610	-3.07		
	Week 3	0.644	5.52	-0.367	-2.78		
	Week 4	0.654	7.54	? -0.402	-4.20		
	Week 5	0.360	6.24	-0.165	-2.19		
	Week 6	0.236	4.13	-0.059	-0.81		
Motorbike	Week 2			1.800	2.16		
	Week 3			0.461	1.47		
	Week 4			? 0.838	3.99		
	Week 5			0.460	2.43		
	Week 6			0.240	1.35		

Policy implications

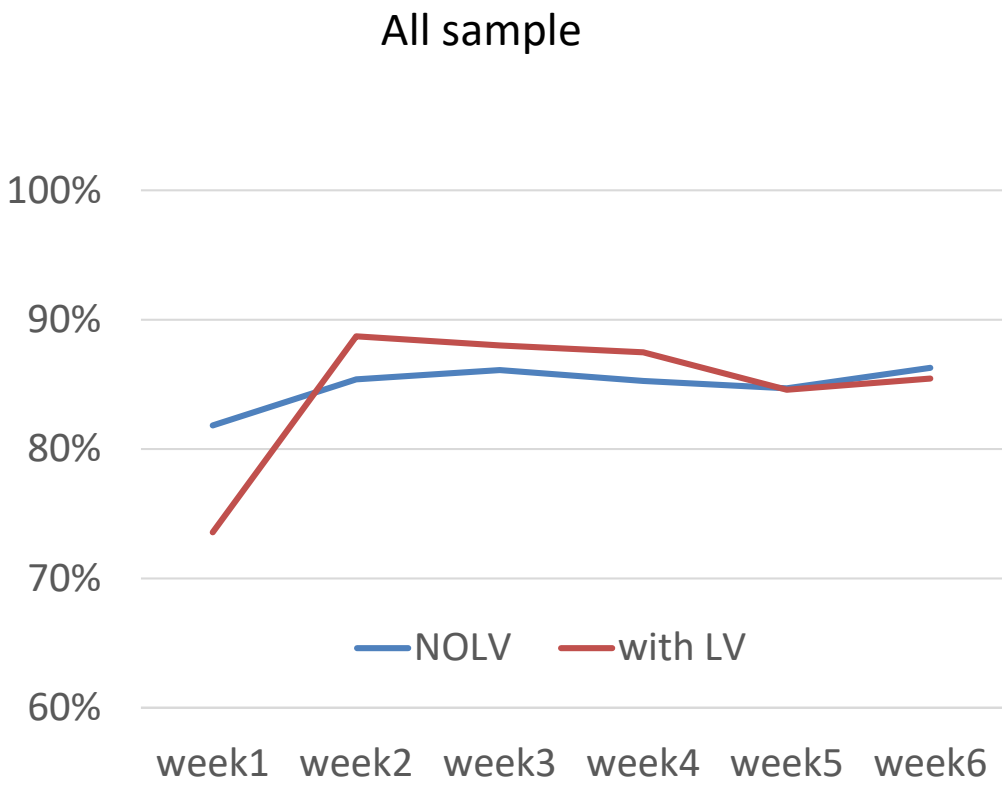


Car driver
Work purpose
1 Car/comp

Scenario +50% car cost



Policy implication



Conclusions

Results indicate that:

- Habitual behaviour and tendency to stick with the alternative chosen in the previous trip measure different effects
- Both effects are significant, but differently for different modes
- Tendency to stick with the same mode is more related to the purpose of the trip than to the time period.
- In this data we could not measure increase in latent behaviour over the 6 weeks

Newcastle University
School of Civil Engineering & Geosciences

Many thanks

Transport Operations Research Group
torg