How to influence the public acceptance of road pricing? The case of Trondheim

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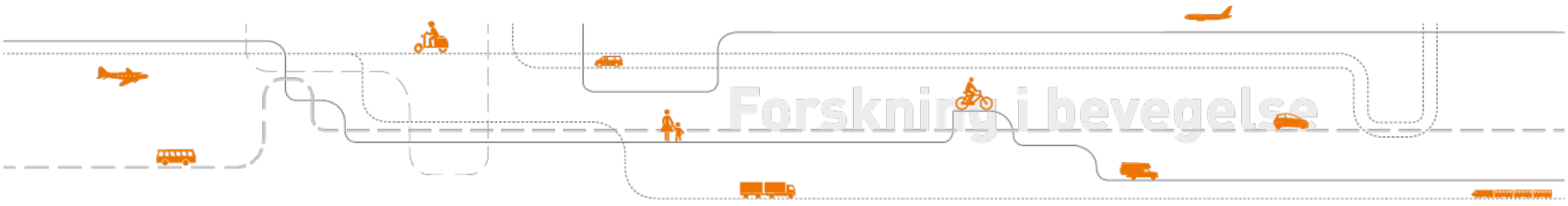


Motivation

Can we influence public opinion?

- Who are those with different opinions?
- Who is more likely to change opinion?
- What issues make opinions shift?

Example of public acceptance of congestion pricing in Trondheim

The importance of public opinion on toll schemes (or is it important?)

Outline

- Toll scheme in Trondheim
- The public opinion survey of 2014
- Model to capture opinion change
- Estimation results
- Some conclusions & further work

The Trondheim scheme 1991 -

1991: The scheme was introduced, 12 toll stations.
Toll fee NOK 10 only during peak hours.

…

2003: Tolls stations were extended to 29

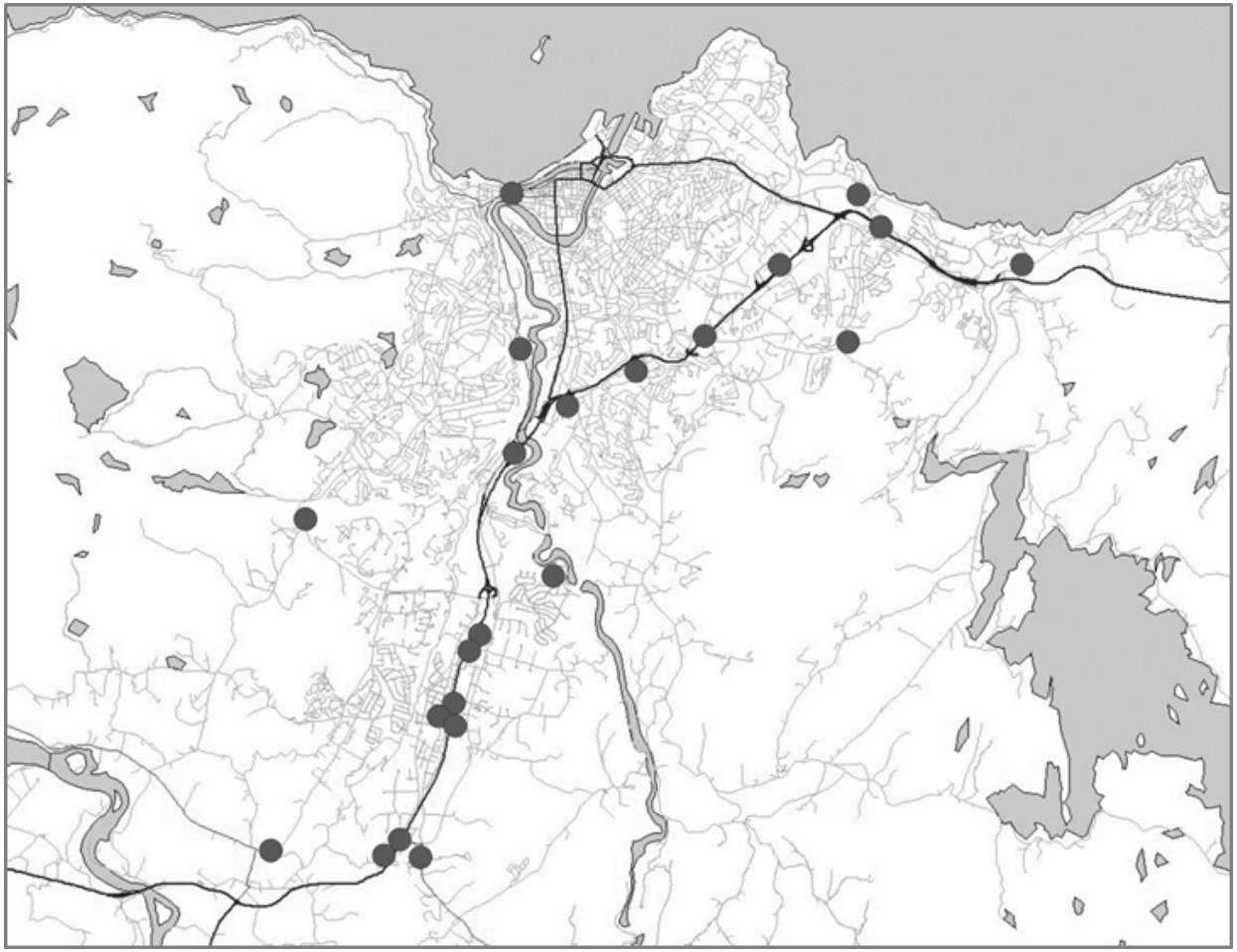
2005: The scheme discontinued

2010: The scheme was reintroduced as an environmental package. 8 toll stations, payment all day, every day.
Fee NOK 10 plus a congestion element (NOK 20 between 07-09 and 15-17)

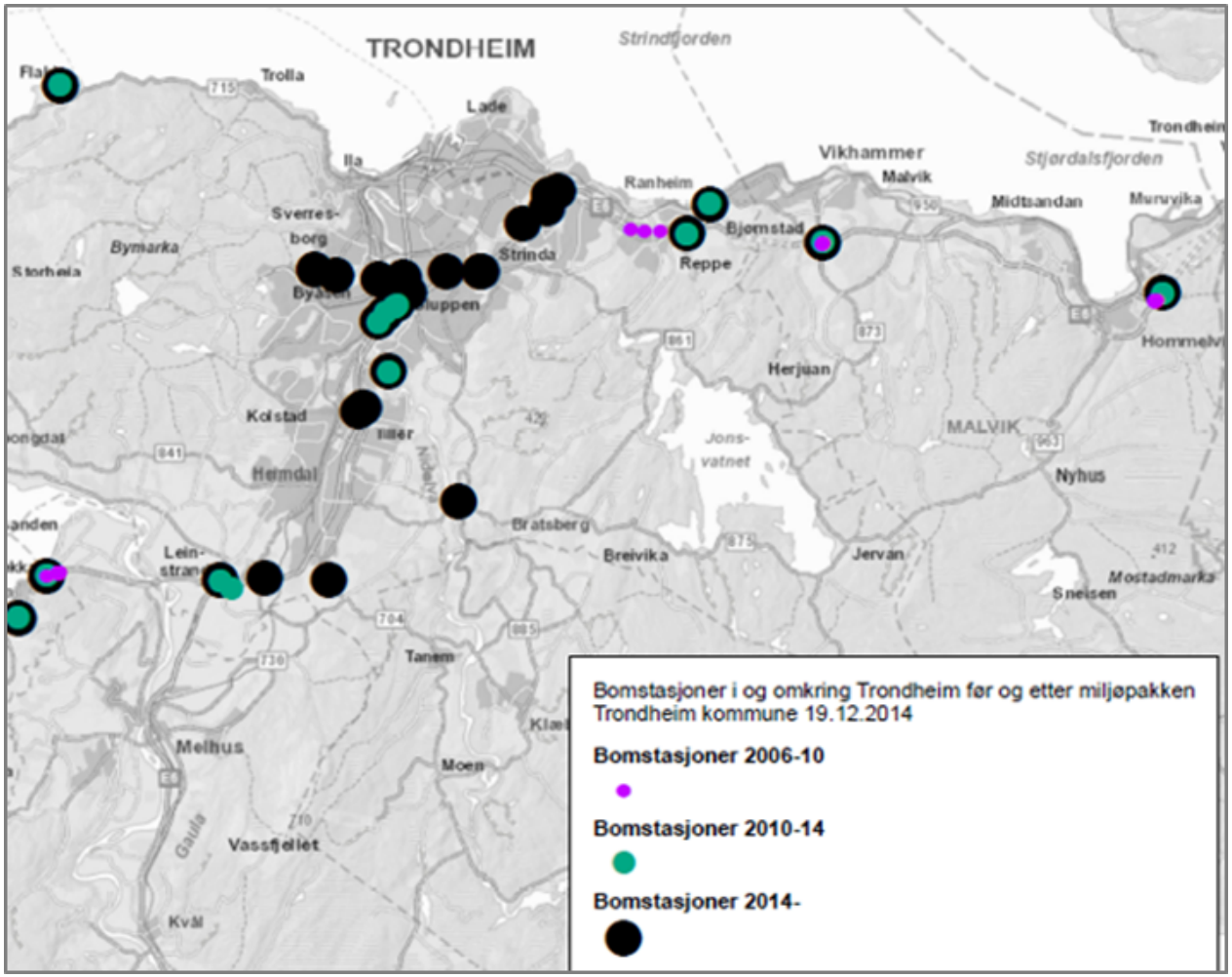
2014: The package was expanded to 22 stations.

$ 1 ≅ NOK 8

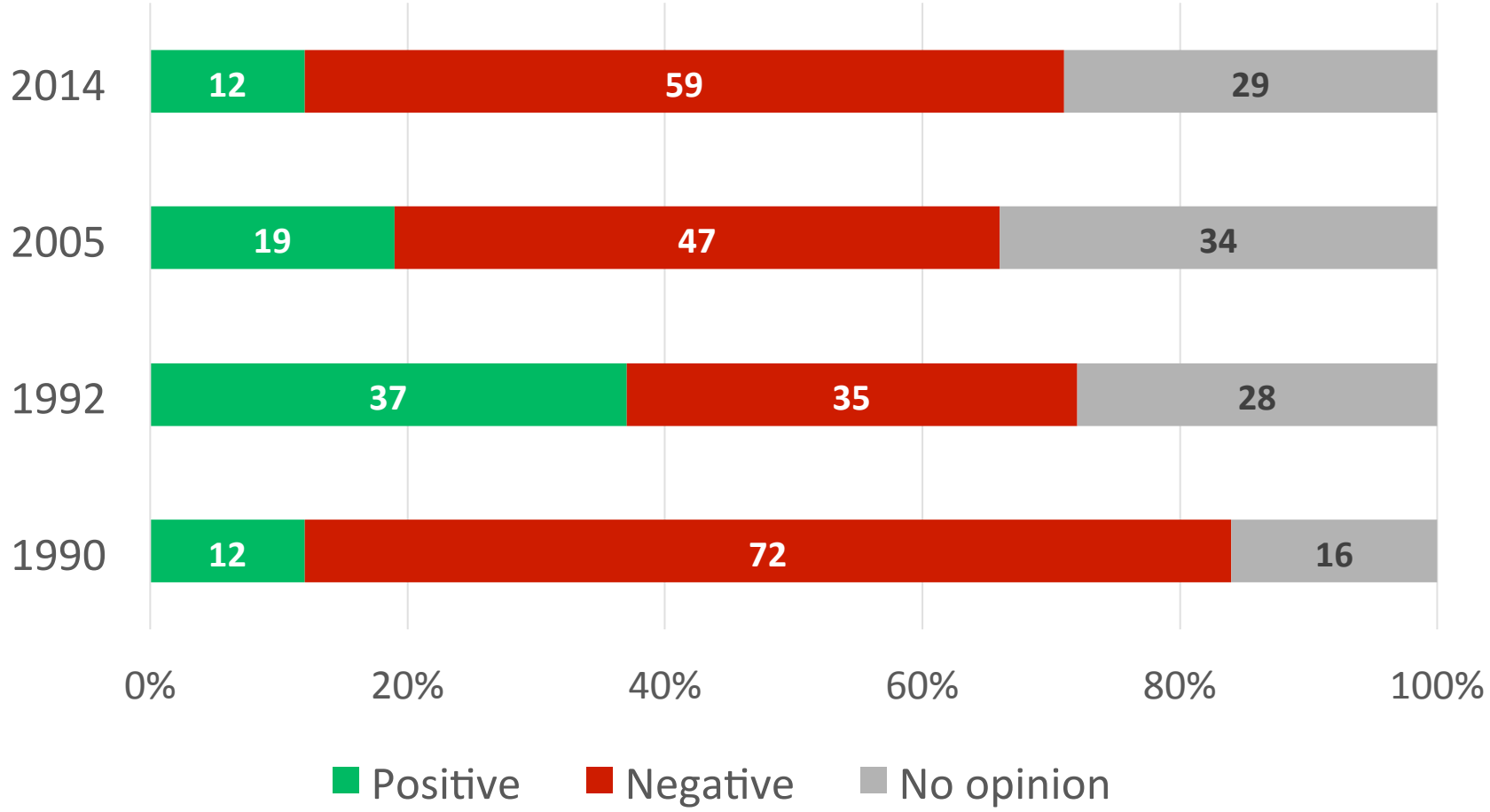
The Trondheim scheme in 2005



The scheme in March 2014



Trondheim scheme: Public opinion since 1990



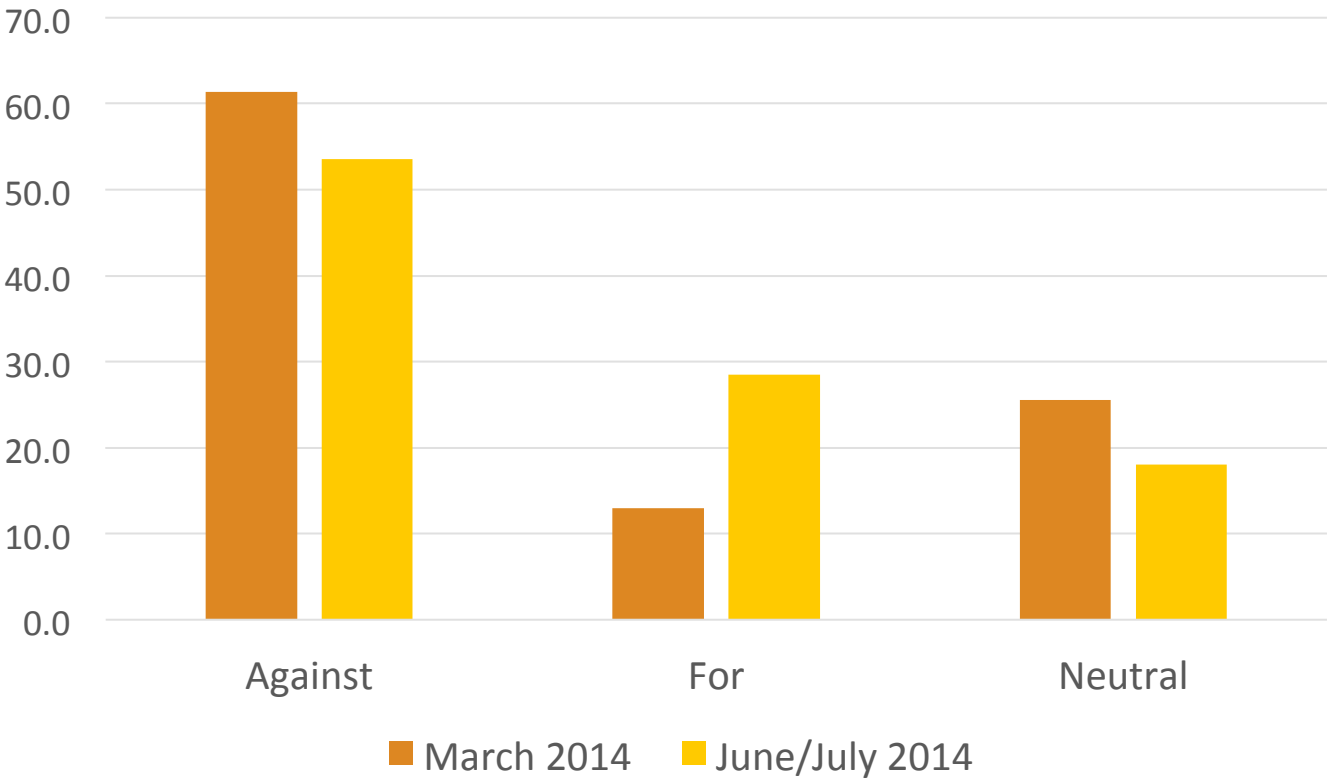
Our study

- Conducted during June 12 - July 18, 2014
- Internet survey, recruited by email from a panel,
- 978 respondents, response rate 20%
- A representative sample
- 39% live inside the toll area, 61% outside
- 62% economically active & 15% students

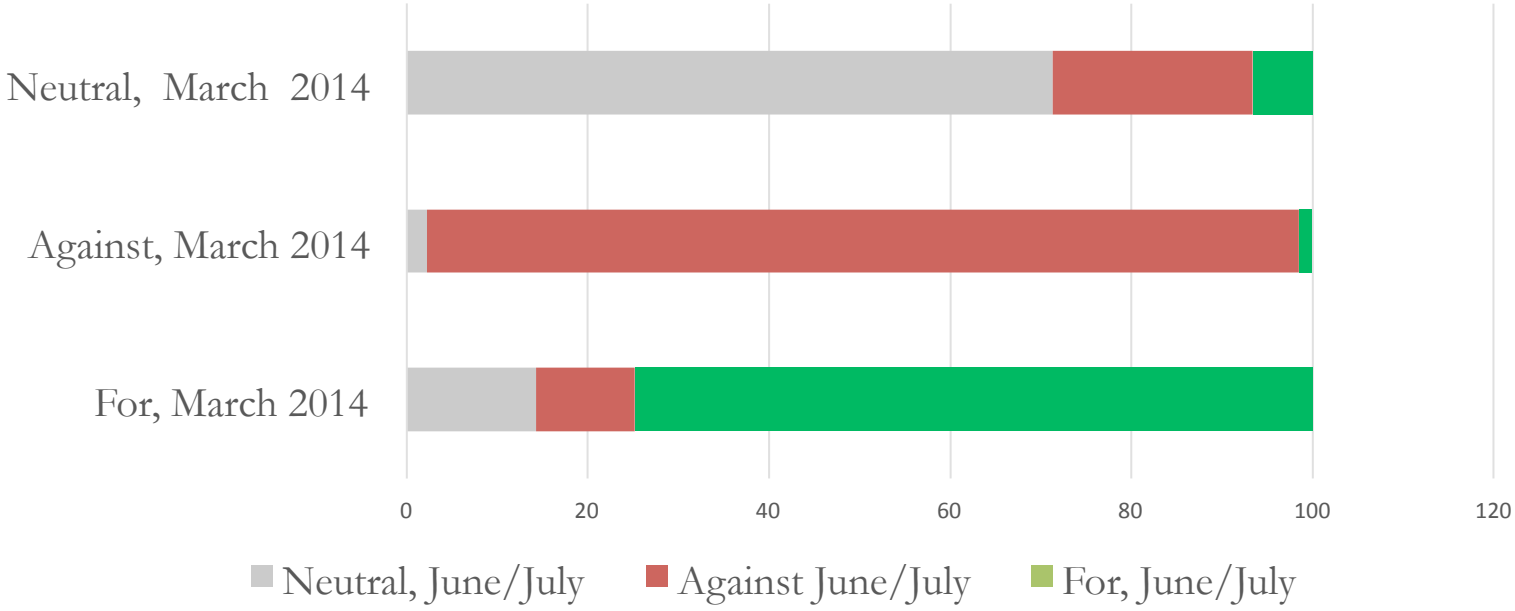
The questionnaire

- Socio-economic data & car ownership
- Home & Work locations and toll crossings
- Travel behavior & changes due to the scheme
- **Were you for or against the toll scheme that was introduced in March 2014? (for, against, neutral)**
- Attitudinal questions, travel habit, etc.
- Perceptions of the traffic, parking, environment, etc.
- **If there were a referendum today, how would you vote for the scheme (for, against, neutral)**
- Income & education

Changes in opinion: March to June/July



Changes in opinion: March to June/July 2014



Attitudinal questions (5 point Likert scale)**:**
Do you agree/disagree with the following statements?

- To drive Car is typically me
- To use PT is typically me
- To Cycle is typically me
- My diving car has negative impact on environment
- My diving car has negative impact on health of others
- It is my responsibility to drive car less
- Important to deal with the emissions from cars
- Subsidies for ownership and use of electric car
- Additional taxes on ownership and use of diesel car
- Tax on cars and motorcycles with high noise

Attitudinal questions (5 point Likert scale):
Do you agree/disagree with the following statements?

- For toll financing of transport infrastructure
- Toll revenues should be used for public transport
- Toll revenues should be used for roads

- Free PT to reduce road congestion
- For discount outside peak hours

- Taxes in Norway are too high
- State & local governments should reduce inequality in society
- Reduced toll fee for low income people

The model: Ordered probit model

Assumption: Attitude (**for**, **neutral** or **against** the scheme) is driven by an (unobserved) latent variable.

Define two distributed latent variables for participant *n*: B*n** before and A*n** after:

$$Bn^* = V(Xn;\ \beta) + N(0,1)$$

$$An^* = V(Xn;\ \alpha) + N(0,1)$$

The difference in attitude before and after the experiment is captured by the difference between the respective coefficient vectors (which represent preferences of the participant), and is caused by the experiment.

To estimate the model we need a measurement equation that links

- low values (of the latent variable) to an attitude "against" the scheme
- medium values to an attitude "neutral" and
- high values to an attitude "for" the scheme.

We define two cut-off points δ_1 and δ_2;

The behavioural model is then for the choice "before" I_n of respondent n:

$$I_n = \text{against if } B_n^* < \delta_1$$
$$I_n = \text{neutral if } \delta_1 < B_n^* < \delta_1 + \delta_2$$
$$I_n = \text{for if } \delta_1 + \delta_2 < B_n^*$$

The model for the choice "after" H_n is defined similarly.

The probability mass function $P_b(I_n | B_n^*; \delta_1, \delta_2)$ of the choice before I_n by respondent n is then:

$$P_b(\text{against} | B_n^*; \delta_1, \delta_2) = \Phi(\delta_1 - V(X_n; \beta))$$
$$P_b(\text{neutral} | B_n^*; \delta_1, \delta_2) = \Phi(\delta_1 + \delta_2 - V(X_n; \beta)) - \Phi(\delta_1 - V(X_n; \beta))$$
$$P_b(\text{for} | B_n^*; \delta_1, \delta_2) = 1 - \Phi(\delta_1 + \delta_2 - V(X_n; \beta))$$

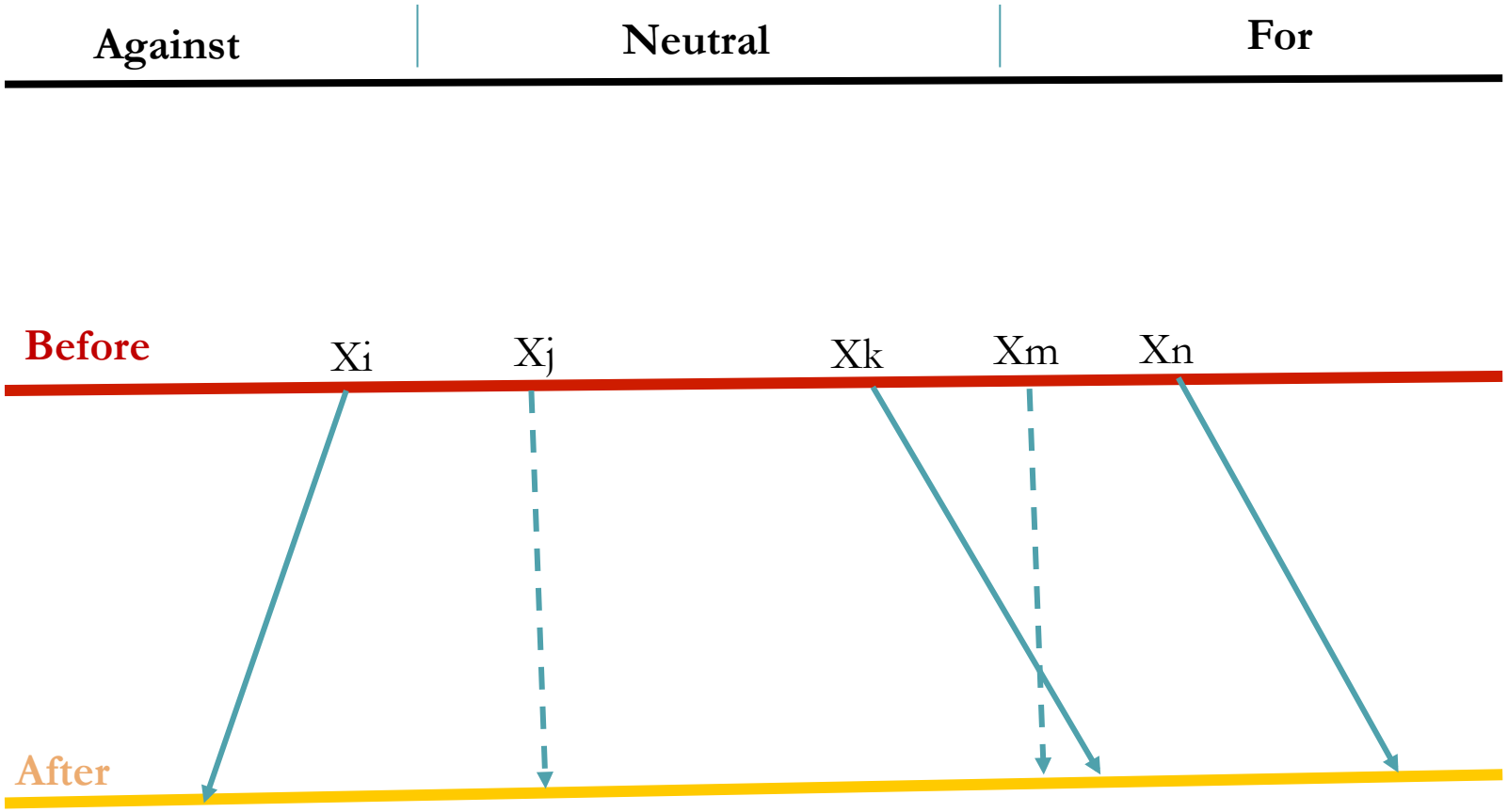
For the choice after we define $P_a(H_n|A_n^*; \delta_1, \delta_2)$ similarly:

$$P_a(\text{against}|A_n^*; \delta_1, \delta_2) = \Phi(\delta_1 - V(X_n; \alpha))$$
$$P_a(\text{neutral}|A_n^*; \delta_1, \delta_2) = \Phi(\delta_1+\delta_2 - V(X_n; \alpha)) - \Phi(\delta_1 - V(X_n; \alpha))$$
$$P_a(\text{for}|A_n^*; \delta_1, \delta_2) = 1 - \Phi(\delta_1+\delta_2 - V(X_n; \alpha))$$

The loglikelihood LL of the observations is then defined by:

$$LL = \Sigma_{n=1...N} [\ln(P_b(I_n|B_n^*; \delta_1, \delta_2)) + \ln(P_a(H_n|A_n^*; \delta_1, \delta_2))]$$

We then estimate the model by identifying the coefficient values for α, β, δ_1 and δ_2 that maximise the LL of the observations I_n, H_n.


Against
Neutral
For
Before
Xi
Xj
Xk
Xm
Xn
After

		After		Before	
Name		**Value**	**t-test**	**Value**	**t-test**
HH car >0		-0.2776	-2.164	-0.4415	-3.613
Toll crossing>5/week		-0.2342	-2.317	-0.1791	-1.694
Cycle trips/week		0.2794	2.697	0.1811	1.857
Car trips/week		-0.3074	-2.768	-0.02290	-0.1955
Home inside toll		-0.1100	-1.142	-0.1904	-1.871
Shopping trips changed		-0.3776	-3.119	-0.3700	-2.829
Women		-0.1706	-1.875	-0.2522	-2.845
toll stations H-W >0		-0.2925	-2.703	-0.2670	-2.534
Att: Car is me		-0.03308	-0.2999	-0.2825	-2.366
Car not good for Env		0.2528	2.213	0.1480	1.220
Should drive lees		0.2436	2.274	0.1197	1.105
Agree with toll financing		0.6571	7.547	0.5000	5.778
Taxes are high in Norway		-0.8161	-7.594	-0.7046	-6.358
Patking is expensive		0.3294	3.377	0.2646	2.677
Air quality is poor		-0.2924	-3.187	-0.2551	-2.835
PT services are poor		0.08488	0.6212	0.2405	2.011
Toll vehicles with H noise		0.1689	1.647	0.2601	2.716
M_C_0		-0.07761	-0.3764	-0.2617	-1.278
M_D_0		0.7825	15.64	1.238	18.62

Estimation Results:

	Before	after
Number of estimated parameters:	30	30
Sample size:	978	978
Excluded observations:	0	0
Init log likelihood:	-1087.835	-1106.195
Final log likelihood:	-733.347	-770.664
Likelihood ratio test for the init. model:	708.975	671.061
Rho-square for the init. model:	0.326	0.303
Rho-square-bar for the init. model:	0.298	0.276

Name	Value	t-test	Value	t-test
ASC	-0.01341	-0.07204	-0.01341	-0.07204
HH Car >0	-0.4101	-3.598	0.1116	0.9821
Toll crossings > 5/week	-0.1759	-1.765	-0.06668	-0.7282
Cycle trips /week	0.1697	1.856	0.1283	1.456
Car trips /week	-0.02194	-0.1984	-0.3021	-2.906
Home inside toll	-0.1801	-1.886	0.06480	0.7319
Low income < 200000/year	-0.1404	-1.410	0.2374	2.022
Age	-0.03100	-0.3057	0.1639	1.692
Shopping trips changed	-0.3466	-2.808	-0.05132	-0.4460
Women	-0.2311	-2.780	0.04969	0.6254
Toll station H_W >0	-0.2487	-2.526	-0.05928	-0.6012
ATT: Car is me	-0.2670	-2.363	0.2366	2.284
Car not good for health	0.1971	1.899	0.02685	0.2592
Agree with toll financing	0.4652	5.733	0.2281	2.853
Taxes high in Norway	-0.6677	-6.324	-0.1828	-1.900
Parking is expensive	0.2518	2.722	0.09300	0.9443
Air quality is poor	-0.2397	-2.847	-0.06459	-0.7629
PT services are poor	0.2246	1.996	-0.1356	-1.085
Poor walking/cycling facilities	-0.1939	-1.746	0.1881	1.533
Toll vehicles with H noise	0.2425	2.707	-0.06486	-0.7005
M_C_0	-0.1710	-0.8873		
M_D_0	0.9921	21.71		

Estimation Results:

Number of estimated parameters:	59
Sample size:	978
Excluded observations:	0
Init log likelihood:	-2194.030
Final log likelihood:	-1520.345
Likelihood ratio test for the init. model:	1347.370
Rho-square for the init. model:	0.307
Rho-square-bar for the init. model:	0.280

Conclusions:

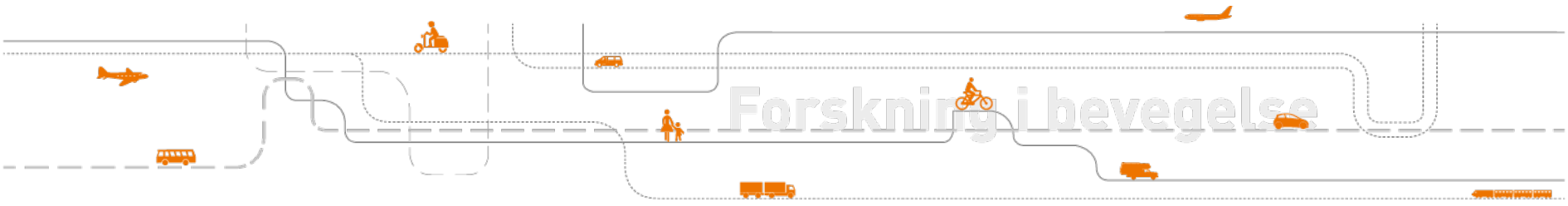
- Observed variables
  - Low income ⇒ More positive
  - Older respondents ⇒ More positive
  - Regular car drivers ⇒ More negative

- Behavioural variables that caused change in attitude:
  - Driving car is typically me ⇒ More positive
  - Toll financing of transport infrastructure ⇒ More positive
  - Taxes in Norway are high ⇒ More negative

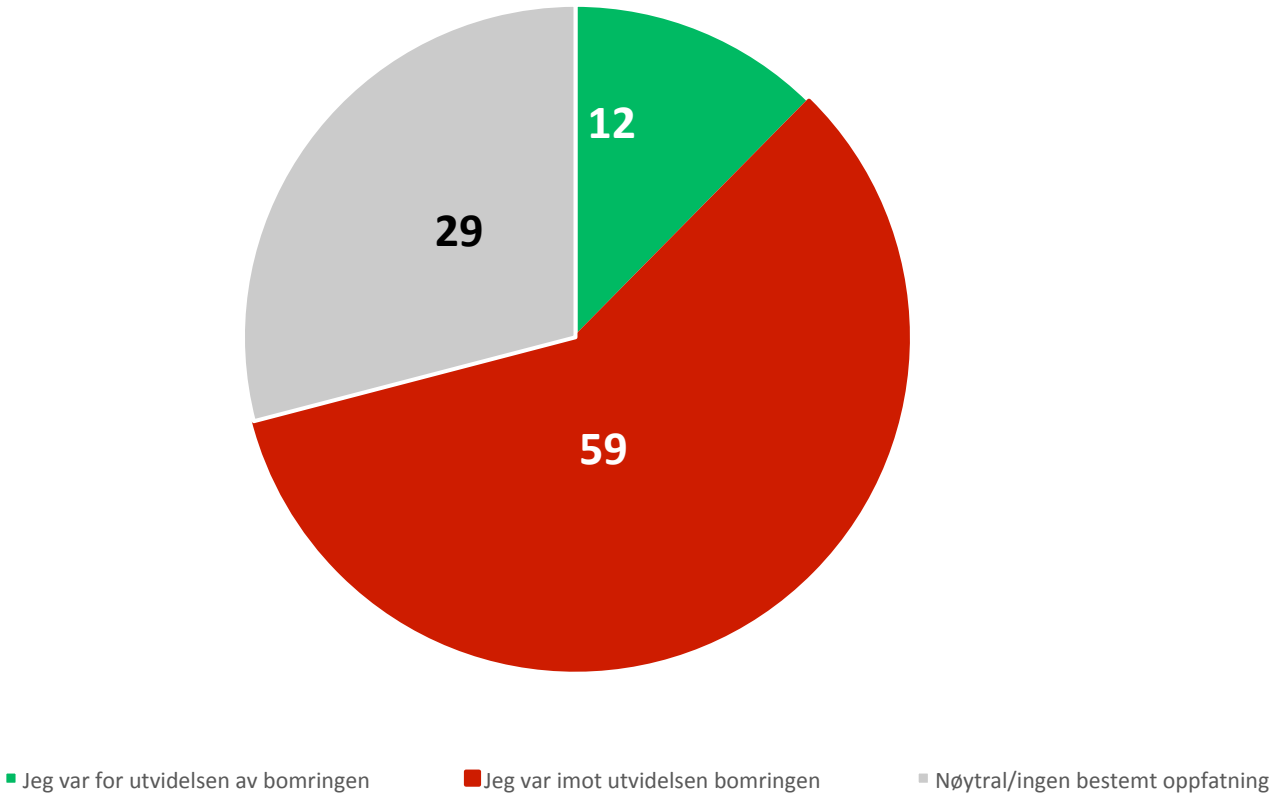
Further work: ?

Thank You

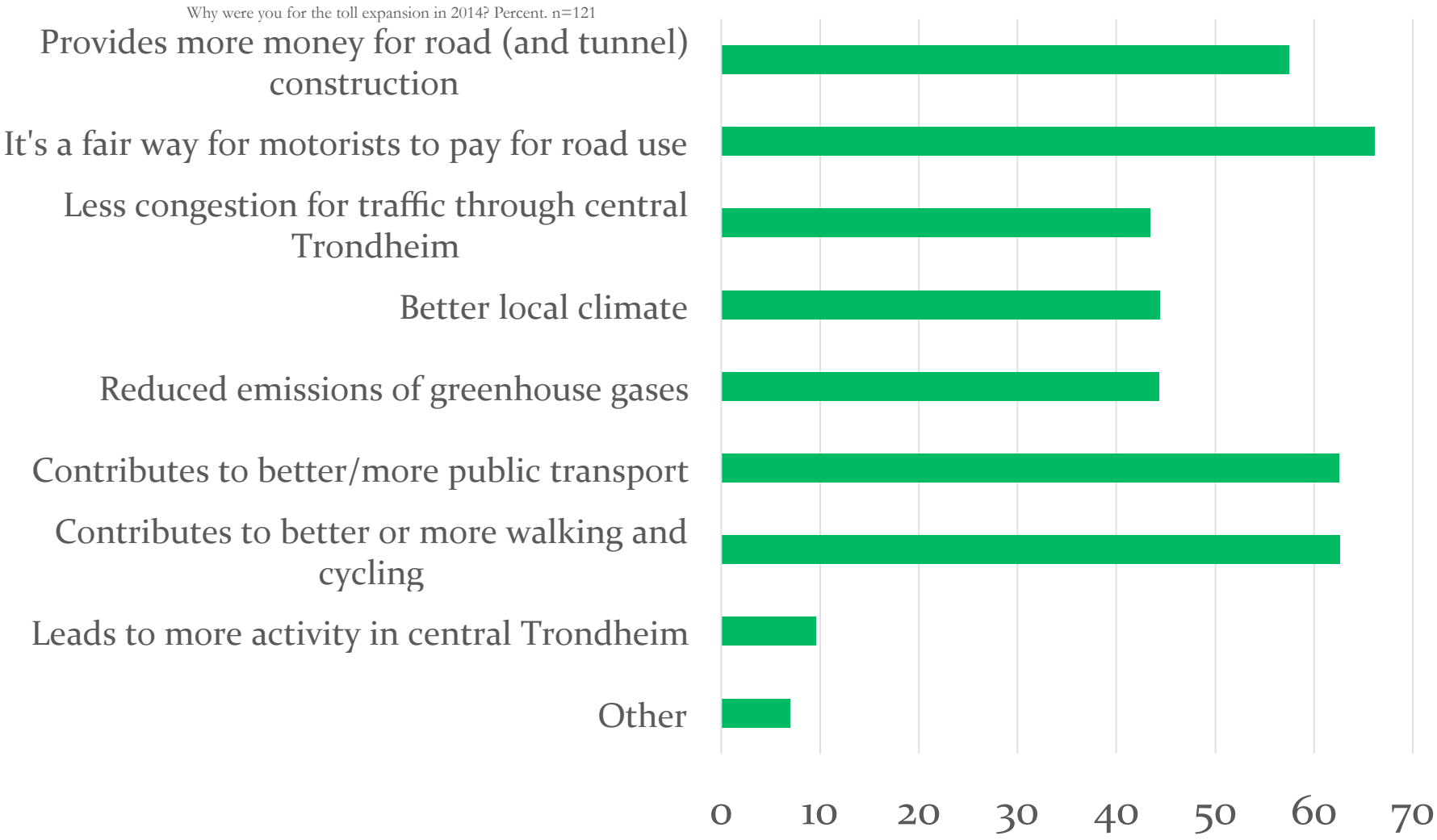
Questions and suggestions?



Were you for or against the toll scheme that was introduced in March 2014? Prosent, n=978



Why were you for the 2014 toll scheme?



Why were you against the 2014 toll scheme?