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Norwegian Public Roads Administration

Identifying indicators for value for money in the front-end of road projects: Using National Transport Plan data from Norway and Sweden

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Motivation

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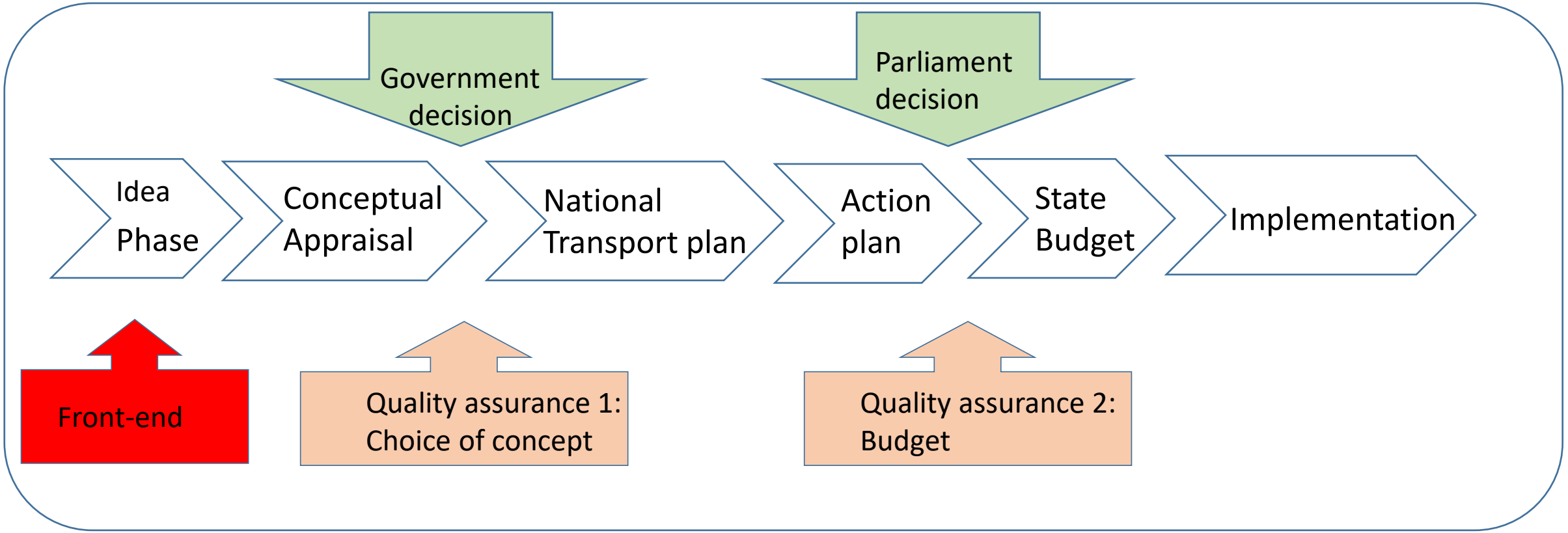
- Value for money as measured by the NPVs per Euro invested is an important and integral part of Norwegian/Swedish road planning processes.

- We observed that the number of projects with low/negative value for money being considered for investment at the National Transport Plan level was high in both countries.

- It seemed that one is caught up in optimizing low value for money rather than ensuring that projects with a low value are filtered out earlier at the front end in the planning process.

Planning process has many stages



Purpose

- Identify factors/characteristics that influences value for money of projects (NPV per Euro invested).
- Results can then be used at the front-end of projects to filter out projects that are most likely to have low value for money
- The literature has not provided such a guidance for use at front-end
- NOTE: The problem we are dealing with here is more about the use economic of principals in the management of resources.

Data

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- We use data from three Swedish and one Norwegian National transport plan period (initial number of observation: 1150)

- We add to the data set projects specific characteristics such as population density, centrality index, median income. We also added dummies for country, city and financing form.

Methodology

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- We use descriptive statistics

- Regression analyses (robust OLS):

$$NPV\ per\ invested\ Euro_i = \alpha_0 + \beta_j X_i^j + \partial_m D_m + \epsilon_i$$

Factors that influence value for money (positively or negatively)

- Logit analyses

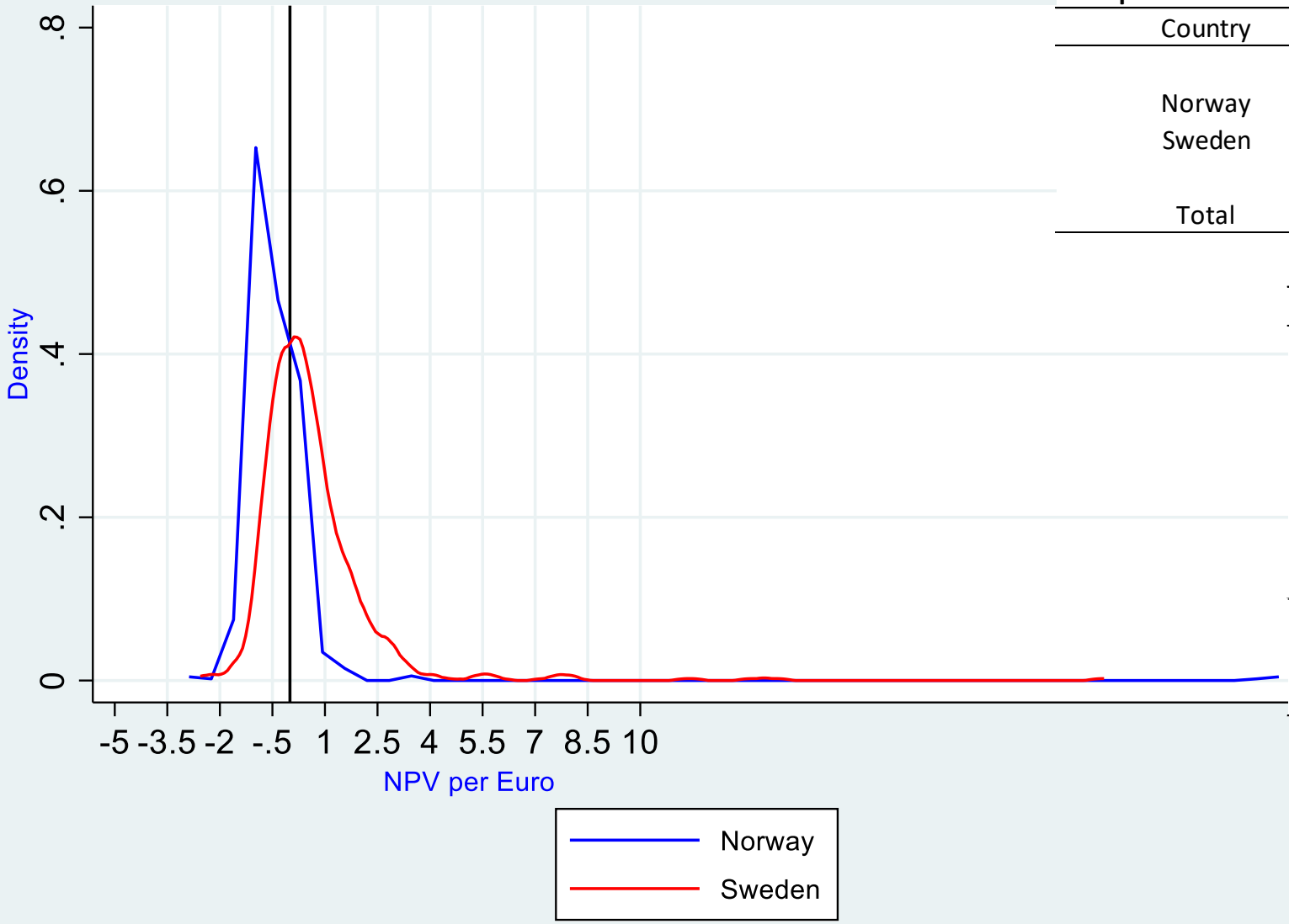
$$P_i = \frac{e^{(\alpha_0 + \beta_j X_i^j + \partial_m D_m + \epsilon_i)}}{1 + e^{(\alpha_0 + \beta_j X_i^j + \partial_m D_m + \epsilon_i)}}$$

Factors that influence the probability that value for money will be positive(or negative)

In addition we did regression for benefit and investment cost separately

Results

(1) Swedish projects have higher value for money than Norwegian projects



NPV per Euro statistics - Norway vs Sweden

Country	Mean	Min	Max	Stdev
Norway	-0.49	-1.56	2.95	0.48
Sweden	0.64	-2.56	23.24	1.81
Total	0.32	-2.56	23.24	1.64

To-utvalgs Wilcoxon rank-sum (Mann–Whitney) test

Country	Obs	Rank sum	Expected
Norway (0)	219	46143	86834
Sweden (1)	573	267886	227195
Combined	792	314028	314028

Test statistics

Null hyptohesis H0: NNB(Norge) = NNB(Sverige)	
Z	-14.131
Prob>|Z|	0.0000

(2) Smaller projects (<100 mill euro) have higher returns than bigger projects

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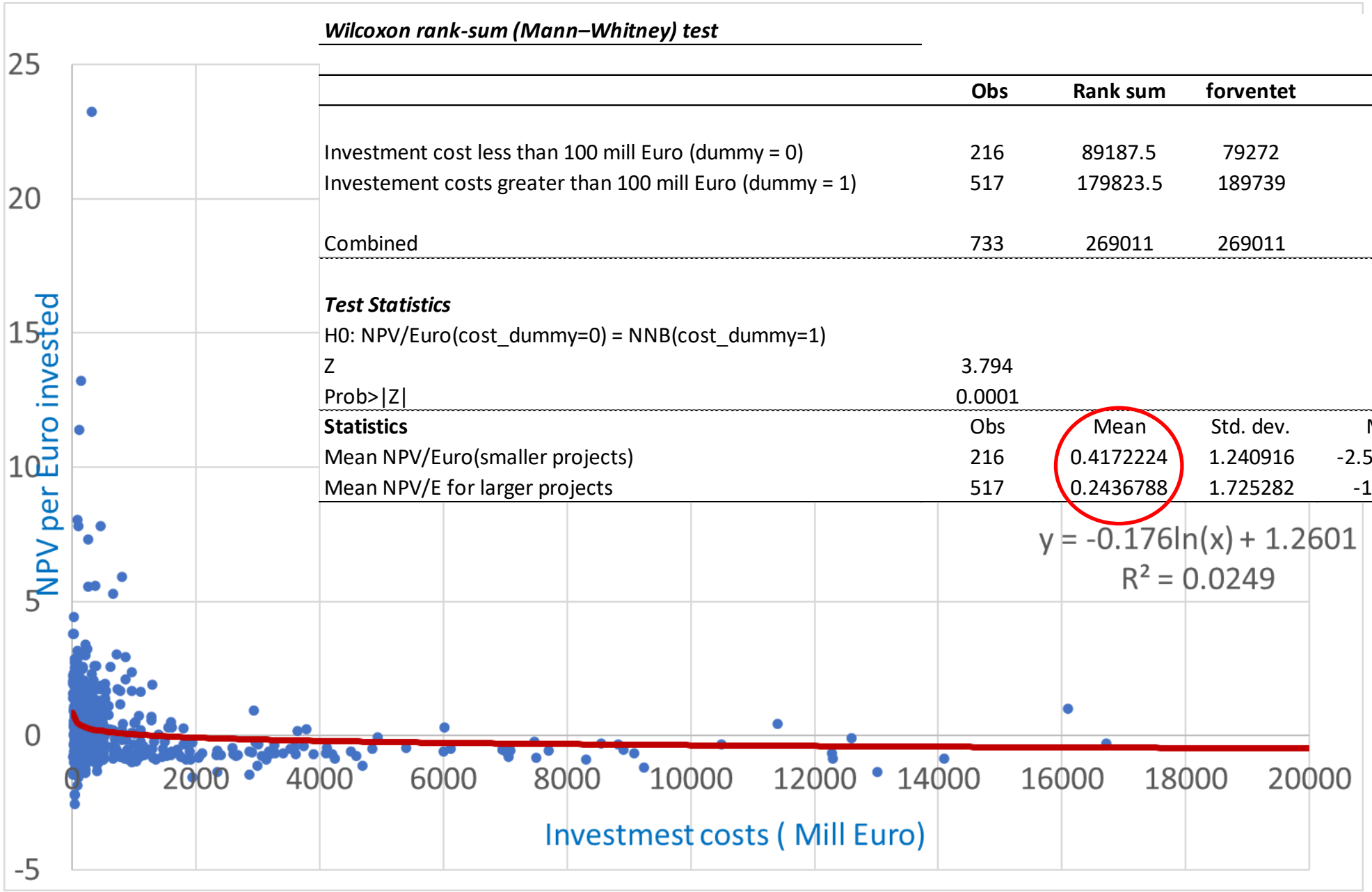
Wilcoxon rank-sum (Mann–Whitney) test

	Obs	Rank sum	forventet	-	-
Investment cost less than 100 mill Euro (dummy = 0)	216	89187.5	79272		
Investement costs greater than 100 mill Euro (dummy = 1)	517	179823.5	189739		
Combined	733	269011	269011		

Test Statistics

H0: NPV/Euro(cost_dummy=0) = NNB(cost_dummy=1)	
Z	3.794
Prob>|Z|	0.0001

Statistics	Obs	Mean	Std. dev.	Min	Max
Mean NPV/Euro(smaller projects)	216	0.4172224	1.240916	-2.557864	8.056151
Mean NPV/E for larger projects	517	0.2436788	1.725282	-1.557	23.24



(3) Swedish projects carry more traffic, longer in length and cheaper

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	AADT		Investment costs pr km (mill.Euro)		Road length in km	
	Norway	Sweden	Norway	Sweden	Norway	Sweden
No. of obs	286	425	254	225	286	769
Mean	5656	5817	13	4	7	10
Min	0	0	6	0	0	0
Max	90000	132830	37	25	82	100
Stdev	11026	13963	5	4	14	10
Test statistics						
z	4.332		16.492		9.379	
Prob <|z|	0.000		0.000		0.000	
Test results	***Sweden > Norway***		***Sweden < Norway***		***Sweden > Norway***	

(4) Time savings account for 70 -90 % of benefits

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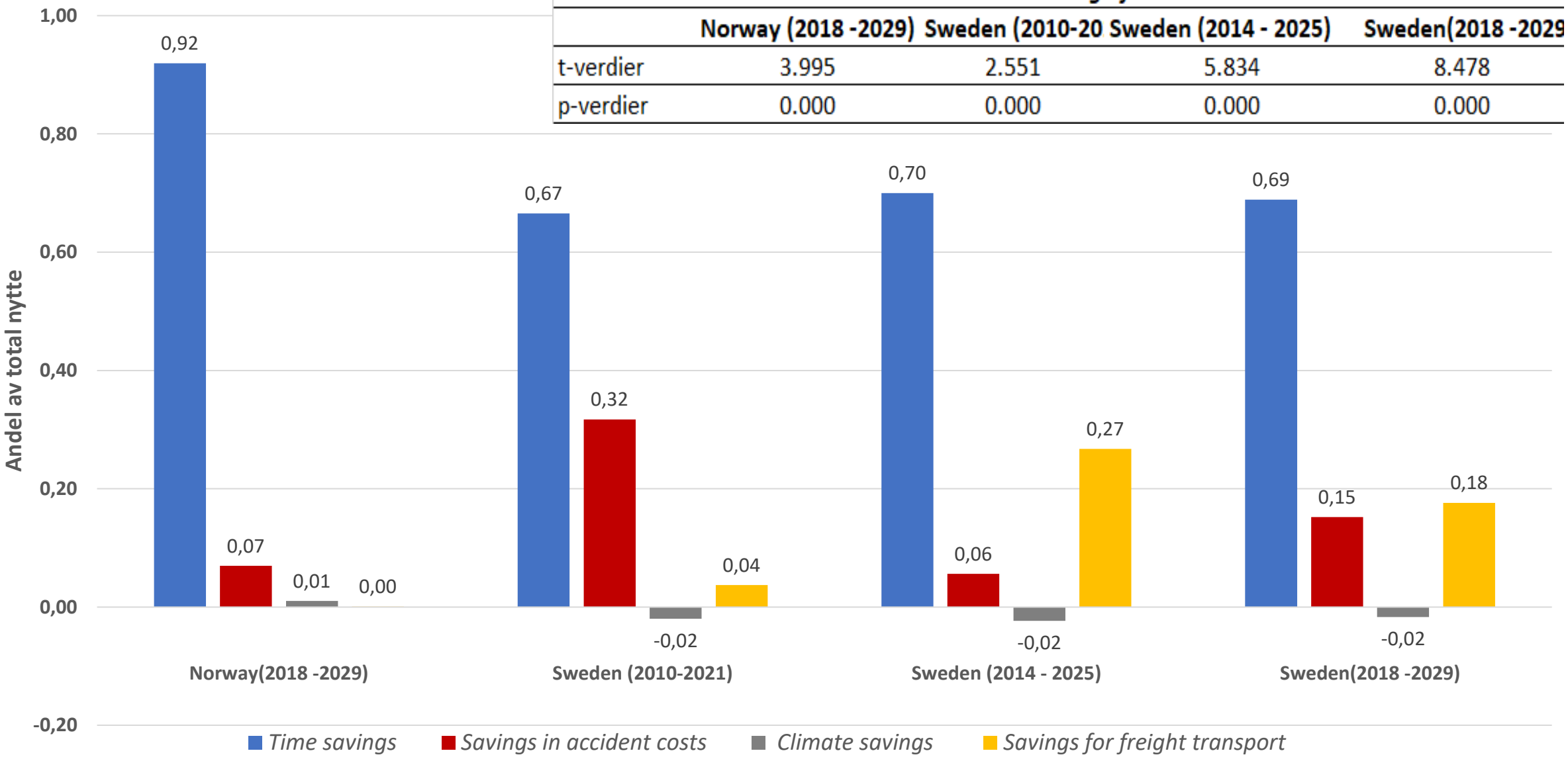
	Norway (2018 -2029)	Sweden (2010-20	Sweden (2014 - 2025)	Sweden(2018 -2029
Significans				
t-verdier	3.995	2.551	5.834	8.478
p-verdier	0.000	0.000	0.000	0.000



Regression model results

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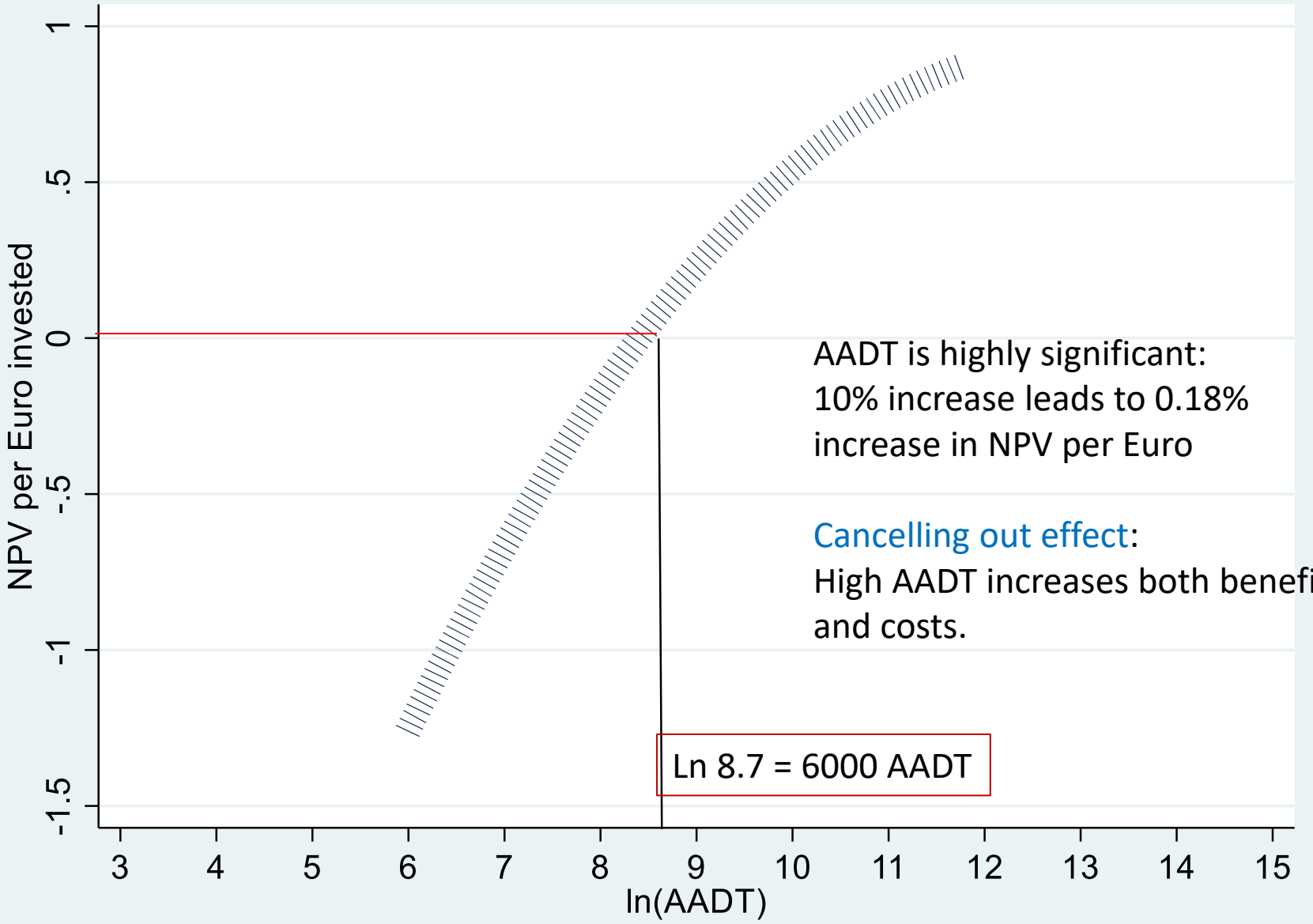
(1) Final model with good explanatory power

Independent variable: Net benefit-cost ratio (nbcr)	Coef.	Std. Err.	t-value	ρ-value		[95% Conf.	interval]
_cons	-2.333	7.605	-0.310	0.759		-17.284	12.618
ln(Aadt)	-3.976	0.850	-4.680	0.000	***	-5.647	-2.305
ln(population density)	2.150	0.394	5.460	0.000	***	1.377	2.924
Co-financed (1 if co-financed; 0 otherwise)	-0.309	0.153	-2.020	0.044	**	-0.611	-0.008
ln(Median net income)	7.269	3.953	1.840	0.067	*	-0.502	15.040
ln(Median net income)^2	-1.002	0.578	-1.730	0.084	*	-2.138	0.134
Metropolitan regions (1 if metroplitan; 0 otherwise)	0.435	0.174	2.490	0.013	**	0.092	0.777
ln(Aadt)^2	0.323	0.057	5.680	0.000	***	0.211	0.435
ln(population density)^2	0.049	0.022	2.280	0.023	**	0.007	0.092
ln(pop)x ln(aadt)	-0.303	0.056	-5.400	0.000	***	-0.413	-0.193
Country dummy (1 if Sweden and 0 if Norway)	1.567	0.531	2.950	0.003	**	0.524	2.610
Adjusted R^2	0.460						
Prob>F	0.000						
RMSE	0.987						
number of obs	413						
- No of Norwegian obs	197						
- No of Swedish obs	216						

***ρ < 0.01; ** ρ <0.05; *ρ < 0.1

(2) AADT is significant – influences both benefits and cost



AADT versus costs per km road

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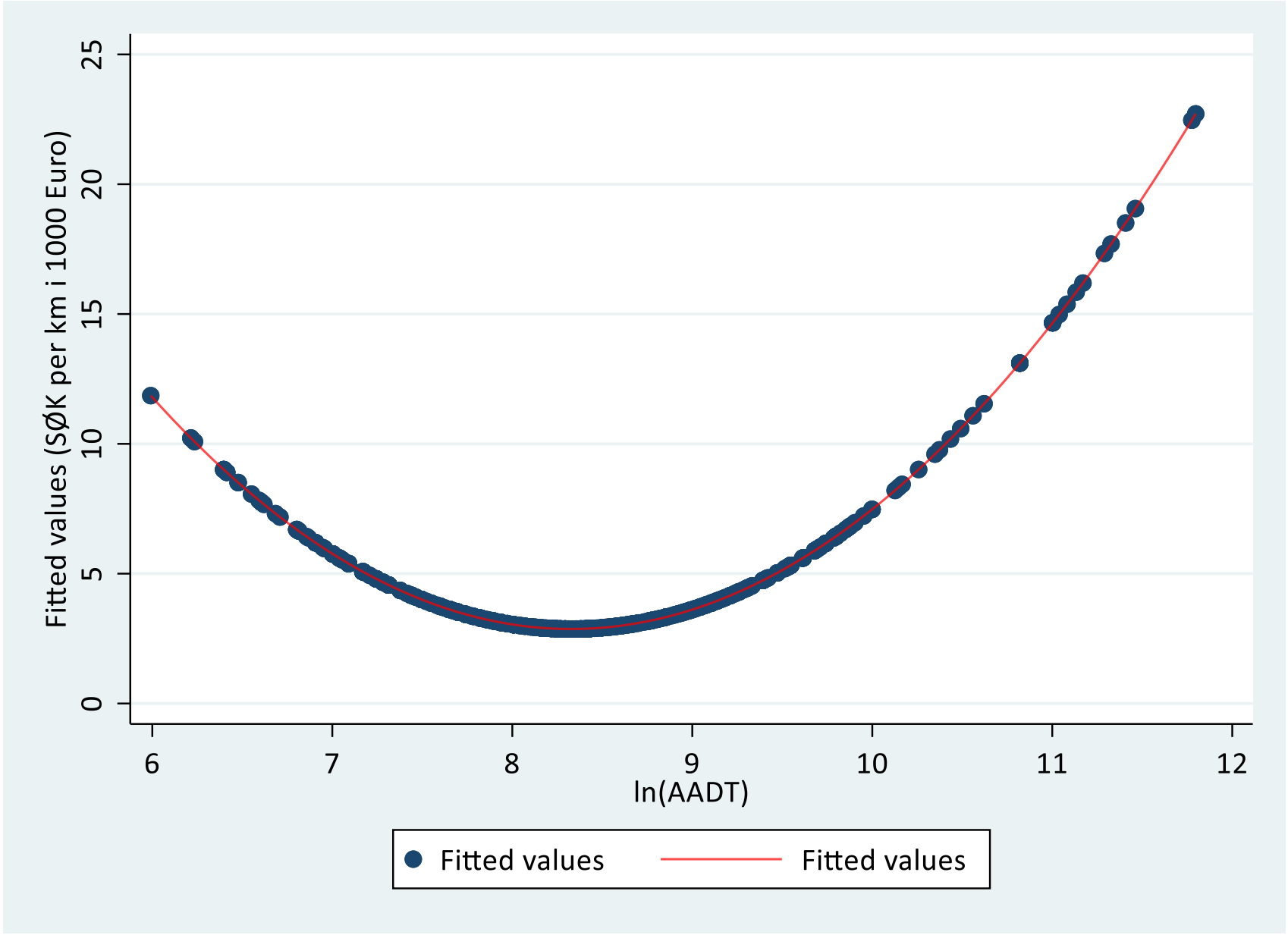

(3) Low benefits from projects in dense areas

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The coefficient for population density is negative and significant.

Reason: extremely expensive to build in dense areas

- However: the interaction term between AADT and density is positive. The positive effect of AADT is greater than the negative effect of density.

(4) Co-funding e.g., tolling reduces value for money

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The coefficient is negative and significant: a project with a return of 0.2 NPV/Euro invested will have a return 0.04 if funded by tolls.

Reason:

Efficiency loss is much greater than the reduction in government funding such that the total effect of tolling on value for money is negative

(5) Centrality matters – has positive impact

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Not to be confused with density

A road project can high centrality e.g., a by pass, without being in a dense area.

Centrality has a positive effect on value for money

Reason: Increases accessibility in between dense areas

Conclusion: some basic characteristics of a project likely to have high value for money

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(1) Must have a minimum AADT of 6000

(2) Should not be financed by tolls

(3) Must be in central parts of the countries

(4) Should not be in cities/dense areas

Potential research topic: What explains the differences in investment costs between Norway and Sweden?

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Thanks for listening

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