Feebates as a Fiscal Measure for Green Transportation

Insights from Europe and Policy Implications

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Background

- Transportation is globally the largest final energy consuming sector
- Share in energy use and GHG emissions projected to increase in the future (mainly in non-OECD)
- Deep transport CO_2 reductions required in order to meet the global 2-degrees stabilization target
- It may take time for biofuels and new technologies (hybrids, fuel cells etc.) to be effective fleet-wide
- Basic policies discussed:
  - Fuel economy / CO_2 emission standards
  - Fuel taxes

Vehicle Taxes

- Very different across European countries; taxation is considered a matter of national sovereignty; in most countries vehicle taxes are not fuel-neutral
- But currently most countries base vehicle taxes – at least partly – on CO_2 emissions
- Current taxation schemes in many European countries imply high costs per ton of carbon
- Company car taxation is different; may compromise the effectiveness of such policy instruments

Feebates – A promising type of vehicle tax?

- Cars emitting CO_2 above a threshold (e.g. 120 g/km) pay a fee; those emitting less than the threshold receive a rebate
- If tax rate is constant (for each g/km) then marginal compliance costs are equalized across all car models
  - But most current systems do not apply constant tax rates
- If threshold decreases over the years, feebates provide a credible long-term price signal that can stimulate innovation – technology-neutrally
  - Makes sense because cost of carbon emissions increases over the years

Features of Feebates

- Market-based instrument
- Equivalent to a flexible fuel economy / CO_2 standard
- Oriented to consumers because they directly affect car prices, in contrast to standards that impose an obligation on the supply side
- Can be designed to be revenue-neutral
  - But current real-world applications (e.g. Netherlands, France, Ireland) turned out to be costly for governments
- Not detrimental to consumer welfare: consumers can shift to low-carbon cars in the same segment
- Impressive results from implementation in some countries: significant drop in new-car CO_2 emissions

Our Modelling Approach – 1

- Discrete-choice consumer demand model for differentiated products (automobiles)
- Structural estimation of demand by heterogeneous consumers with Nested Multinomial Logit model (Berry S., *Rand Journal of Economics* 25, 242–262)
- NML model relatively simple, allows for linear estimation techniques for multiple policy simulations without large computational burden (compared to random coefficients model of Berry, Levinsohn & Pakes, *Econometrica* 63, 841–889)
- We use two levels of nests to allow for more consumer heterogeneity – and estimate several variants of the NML model to be more confident that policy conclusions are not specification-dependent

Data

- Automotive data obtained from 'JATO Dynamics' after a tender process
- Coverage: 9 EU countries (AT, BE, DE, DK, GR, IT, NL, PT, ES), period: 1998–2008
- Dataset includes following variables:

Make	CO_2 emissions
Model	Airbag for driver seat offered as standard
Vehicle length	Airbag for passenger seat offered as standard
Vehicle width	Air conditioning system offered as standard
Engine size	Climate control offered as standard
Max. engine power	Segment type
Max. torque	Retail price
Fuel type	Sales volume
Transmission type	
Body type	
Max. speed	
Acceleration 0-100 km/h	
Fuel consumption	

Different model specifications

- Two alternative ways to aggregate observations of the dataset:
  - Cars grouped according to model, engine type (gasoline/diesel) and engine size (e.g. 1151-1250 cc, 1251-1350 cc etc.) (6061 observations)
  - Cars grouped according to model and engine type only (3139 observations)
- Two ways that price enters the demand equation:
  - Linearly (leads to more dispersed elasticities, which are a linear function of price)
  - Logarithmically (produces more dispersed markups; implies constant expenditure)
- IV estimation using standard + alternative approach to select instruments

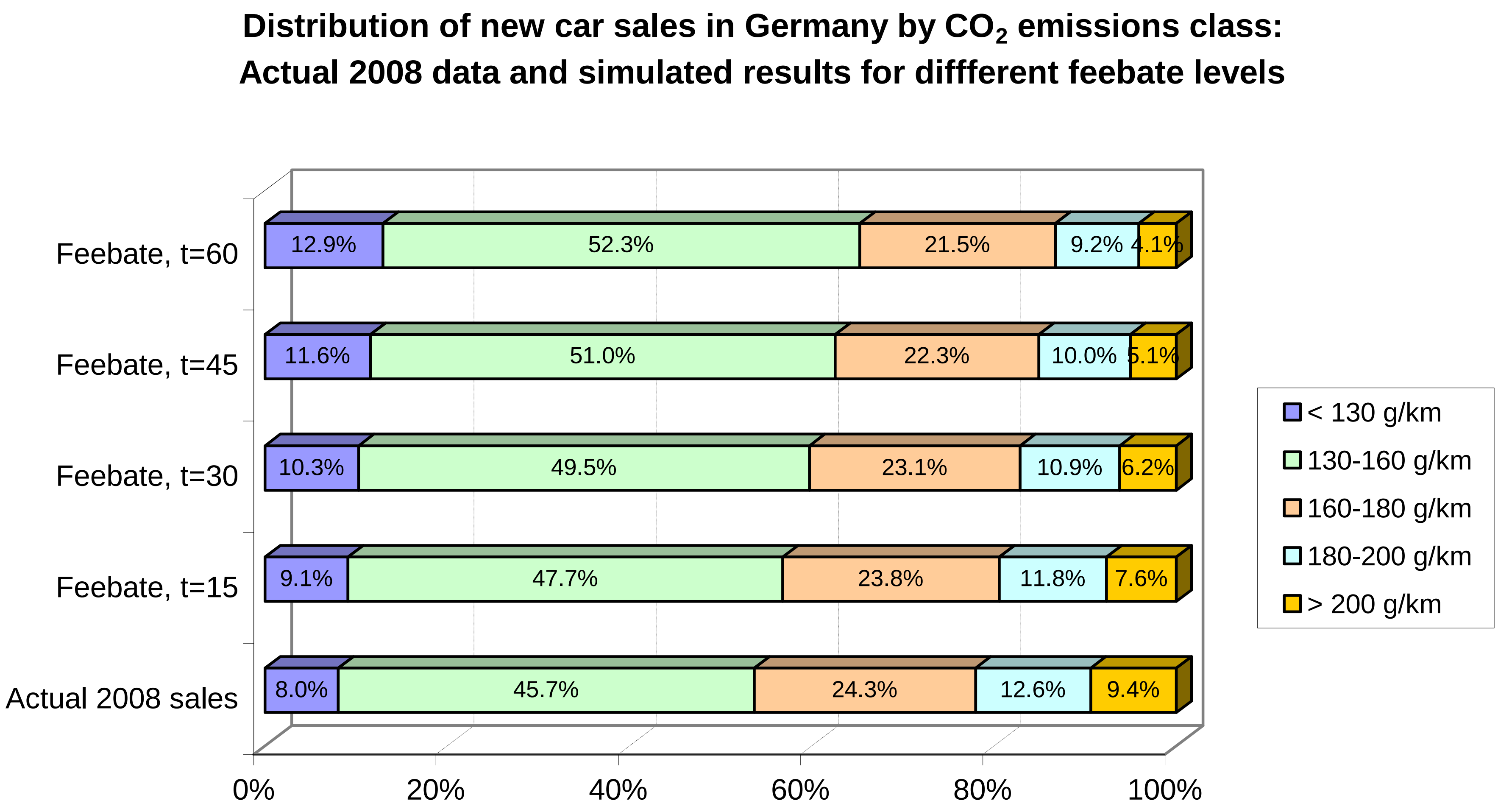
‘Feebate’ Policy Simulations for Germany

- Fee/rebate per vehicle sold according to formula:

$$A = t \times (CO2 - PP)$$

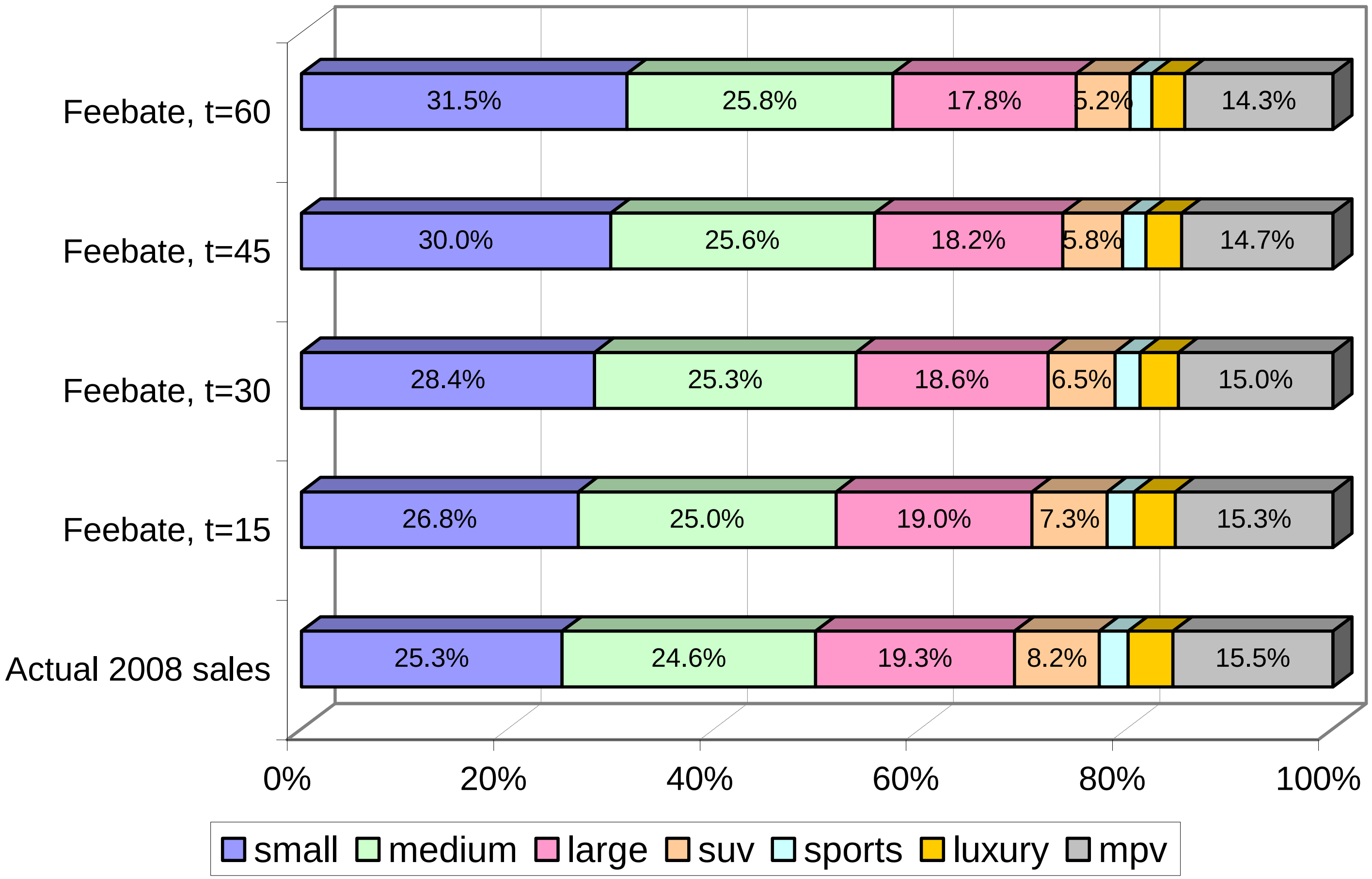
- *A in € , t* in € per g/km
- Cars emitting above *PP* pay a fee; those emitting less than *PP* receive a rebate
- Scenarios for *t* = 15, 30, 45, 60 (corresponding to carbon taxes of 75–300 € / t CO_2), and for pivot points *PP* = 120, 140, 160 g CO_2 / km
- Additional scenarios for revenue-neutral policies, asymmetric feebates and welfare-improving feebates
- Feebate levied at consumer/producer level, passes through (not by 100%) to car price

Comparison of policies according to feebate stringency for a given pivot point – 1



Comparison of policies according to feebate stringency for a given pivot point – 2

Distribution of new car sales in Germany by vehicle segment: Actual 2008 data and simulated results for different feebate levels



Results: Impacts on emissions, public revenues & consumer welfare

Scheme		Change in:				
t	PP	Total sales	Consumer surplus	Producer surplus	Emissions cost	Total welfare
Revenue-neutral symmetric schemes						
10	135.2	-23.8 (-0.8)	-96 (-1.7)	-30 (-0.8)	-60 (-4.2)	-66 (-0.3)
20	132.7	-47.6 (-1.6)	-191 (-3.3)	-58 (-1.5)	-110 (-7.7)	-139 (-0.7)
30	130.2	-71.9 (-2.5)	-288 (-4.9)	-84 (-2.1)	-155 (-10.7)	-217 (-1.0)
40	127.7	-97.3 (-3.3)	-388 (-6.7)	-109 (-2.8)	-196 (-13.4)	-300 (-1.4)
30.7	130	-73.7 (-2.5)	-295 (-5.1)	-86 (-2.2)	-158 (-10.9)	-223 (-1.1)
71.6	120	-186.7 (-6.4)	-732 (-12.6)	-175 (-4.4)	-315 (-20.8)	-593 (-2.8)
Revenue-neutral asymmetric schemes						
-10/+20	130.6	-26.3 (-0.9)	-106 (-1.8)	-34 (-0.8)	-66 (-4.6)	-74 (-0.3)
-20/+10	136.7	-43.5 (-1.5)	-175 (-3.0)	-52 (-1.3)	-101 (-7.0)	-127 (-0.6)
-5/+20	127.2	-14.4 (-0.5)	-58 (-1.0)	-19 (-0.5)	-38 (-2.7)	-39 (-0.2)
-20/+5	139.4	-41.0 (-1.4)	-165 (-2.8)	-49 (-1.2)	-95 (-6.6)	-119 (-0.6)
-10/+30	127.3	-28.2 (-1.0)	-114 (-2.0)	-36 (-0.9)	-70 (-4.9)	-80 (-0.4)
-30/+10	136.6	-61.8 (-2.1)	-248 (-4.3)	-72 (-1.8)	-134 (-9.3)	-185 (-0.9)
-5/+30	123.8	-15.4 (-0.5)	-62 (-1.1)	-21 (-0.5)	-41 (-2.9)	-43 (-0.2)
-30/+5	138.8	-58.8 (-2.0)	-236 (-4.1)	-67 (-1.7)	-127 (-8.8)	-176 (-0.8)
Welfare-improving schemes						
10	130	-29.1 (-1.0)	-118 (-2.0)	-37 (-0.9)	-62 (-4.4)	61 (0.3)
20	120	-73.2 (-2.5)	-293 (-5.0)	-92 (-2.3)	-122 (-8.4)	473 (2.2)
-2/+3	130.6	-6.0 (-0.2)	-24 (-0.4)	-8 (-0.2)	-14 (-1.0)	13 (0.06)
-10/+20	123.8	-34.2 (-1.2)	-138 (-2.4)	-44 (-1.1)	-68 (-4.7)	141 (0.7)
Sales-increasing schemes						
0/+10	120	0.6 (0.02)	3 (0.04)	0.3 (0.01)	-1.5 (-0.1)	-31 (-0.15)
0/+10	140	3.8 (0.1)	15 (0.3)	4 (0.1)	-6 (-0.4)	-167 (-0.8)
0/+10	160	12.7 (0.4)	52 (0.9)	15 (0.4)	-13 (-0.9)	-508 (-2.4)

Conclusions

- It is possible to design a feebate program for new automobiles that curbs carbon emissions without reducing total welfare
- But needs careful design in order to account for trade-offs between environmental effectiveness, public finances and consumer/producer surplus
- Revenue-neutral tax schemes (politically most attractive) may not be welfare-improving *in the short run*; more stringent policies increasing public revenues can improve welfare

➢ But purpose of feebates is to provide long-term price signal, not work miracles in 1-2 years

Limitations & Research outlook

- Non-dynamic model simulates small changes from an equilibrium to another ⇨ may underestimate short-term consumer response
- Dynamic policy simulations necessary to make the analysis more realistic (e.g. more stringent taxation over the years), but needs assumptions about supply side (i.e. technical progress in cars)
- What is the role of changing consumer preferences / shifting demand function?
- What is the effect on i) used cars, ii) mileage?
- Distributional aspects (need to include household data on car ownership & use)