



# Modelling the Impact of a Feebate Scheme on Household Vehicle Choice

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# Motivation and Objectives

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## ▶ **Context**

- ▶ Policy makers around the world are seeking ways to curb CO2 emissions from vehicles
- ▶ France introduced a “feebate” scheme - the Bonus Ecologique - in 2006
- ▶ MEEDDAT wished to have a model for simulating alternative scheme parameters

## ▶ **Objectives**

- ▶ To develop a quantitative model of vehicle choice for French households
  - ▶ To simulate the effects of changing feebate parameters
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# The “Bonus Écologique” Feebate Schedule

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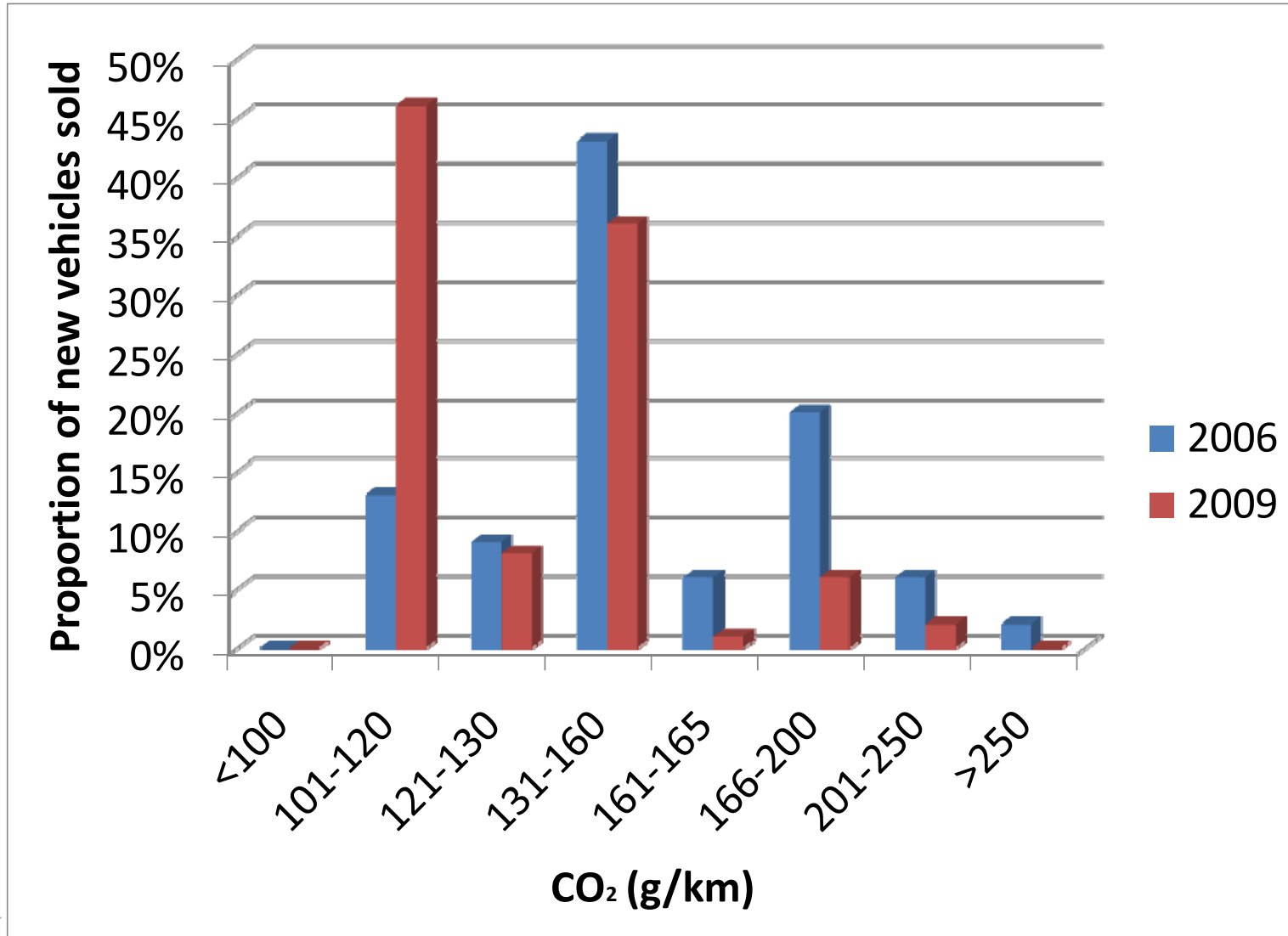
<b>CO2 Group (g/km)</b>	<b>Tax rate (Euros)</b>
<b>&lt;100</b>	<b>-1000</b>
<b>101-120</b>	<b>-700</b>
<b>121-130</b>	<b>-200</b>
<b>131-160</b>	<b>0</b>
<b>161-165</b>	<b>200</b>
<b>166-200</b>	<b>750</b>
<b>201-250</b>	<b>1600</b>
<b>&gt;250</b>	<b>2600</b>

Note: feebates apply to new vehicle sales only.

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# The Impact of the Feebate Scheme on CO<sub>2</sub> Emissions



# Methodology

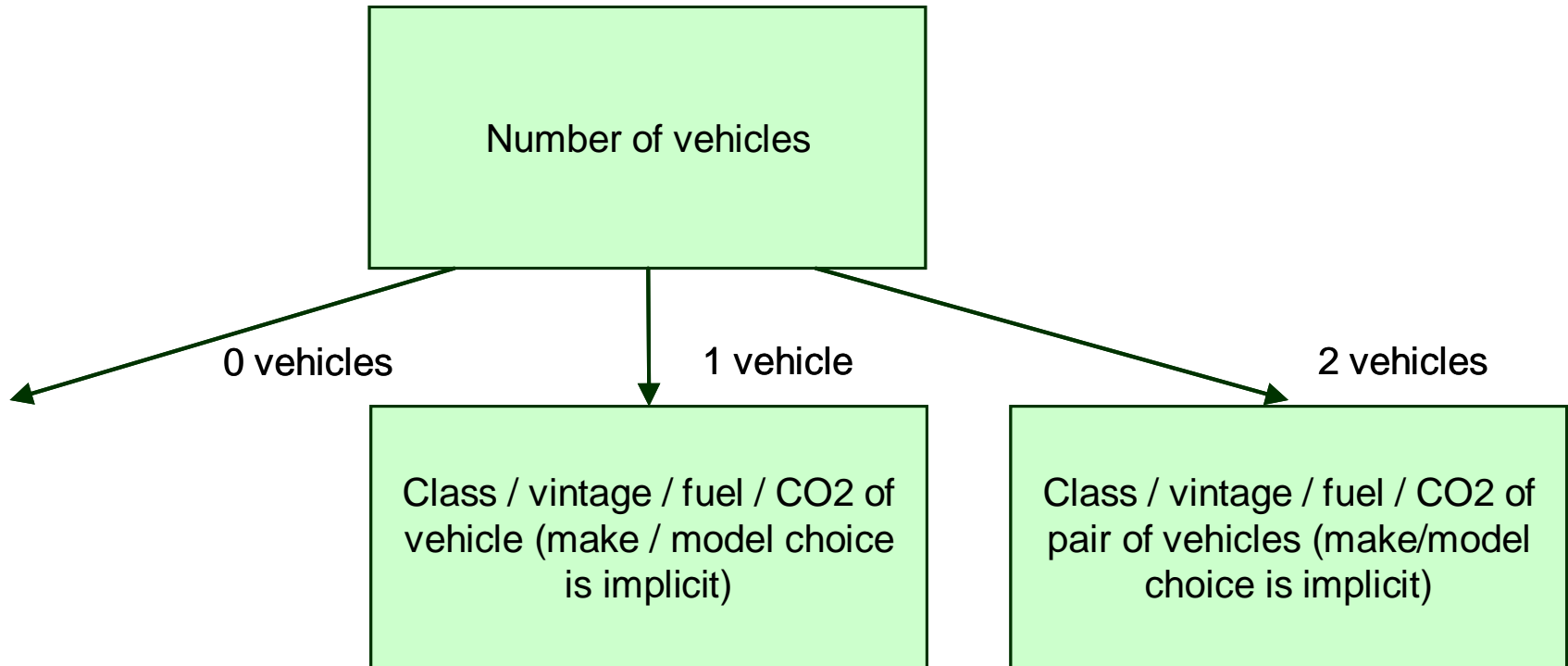
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- ▶ Combine household data (INSEE), vehicle data (L'Argus and JATO), and market data (Fuel prices)
- ▶ Estimate econometric vehicle ownership model
- ▶ Develop simulation tool
- ▶ Perform simulations over Feebate parameters



# Vehicle Choice Model Structure

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# Vehicle Choices

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<b>Class</b>	<b>Vintage</b>	<b>Fuel type</b>	<b>CO<sub>2</sub> band (g/km)</b>
A - Utility / city cars	New (Less than 1 year old)	Petrol	Less than 100
B - Small	Medium-aged (1-5 years old)	Diesel	101-120
C - Lower medium	Old (More than 5 years old)	Other	121-130
D - Upper medium			131-160
E - Large, Executive and Luxury			161-165
Mini MPV			166-200
MPV			201-250
Sports			More than 250
SUV			

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- ▶ 211 Vehicle types available to each household
- ▶ 22,366 Vehicle type pairs



# Econometric Results

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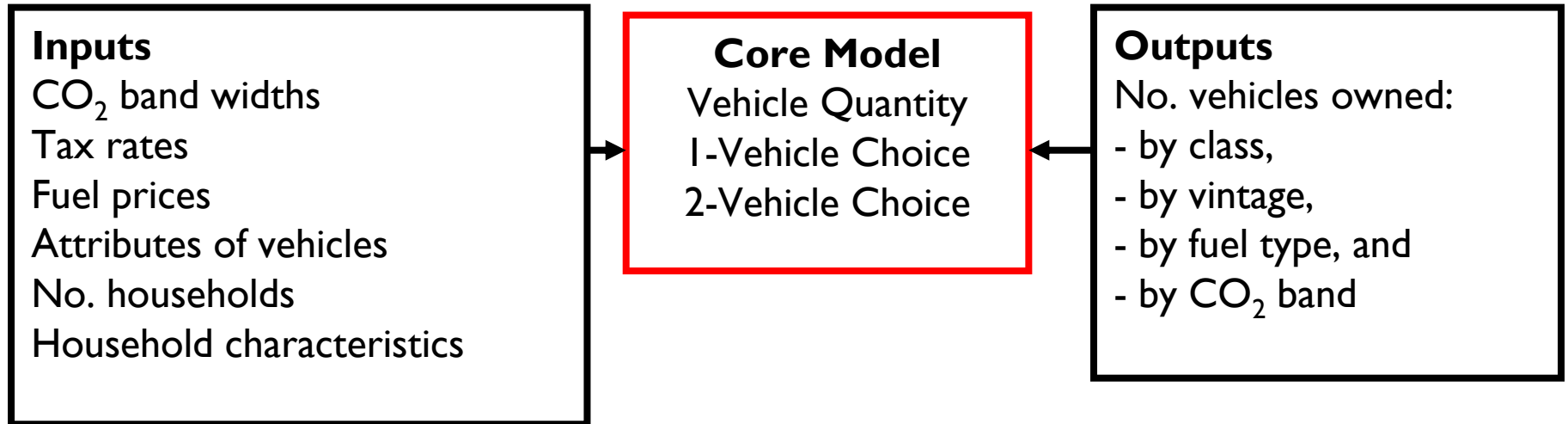
- ▶ **Vehicle quantity choice model**
  - ▶ Sensitivities to income, no. employed, and household size as expected.
  - ▶ Car ownership more likely in rural areas than urban areas.
  
- ▶ **Vehicle type choice models**
  - ▶ Choice responds to purchase prices and variable costs as expected; low income households more sensitive than others.
  - ▶ Households prefer more luggage space, especially larger households.
  - ▶ Households are more attracted to newer vintages, and less attracted to MPVs, SUVs and sports cars, all else equal.
  - ▶ MPVs are relatively more attractive to larger households.
  - ▶ People prefer vehicle types where there are more makes and models available for them to choose from.





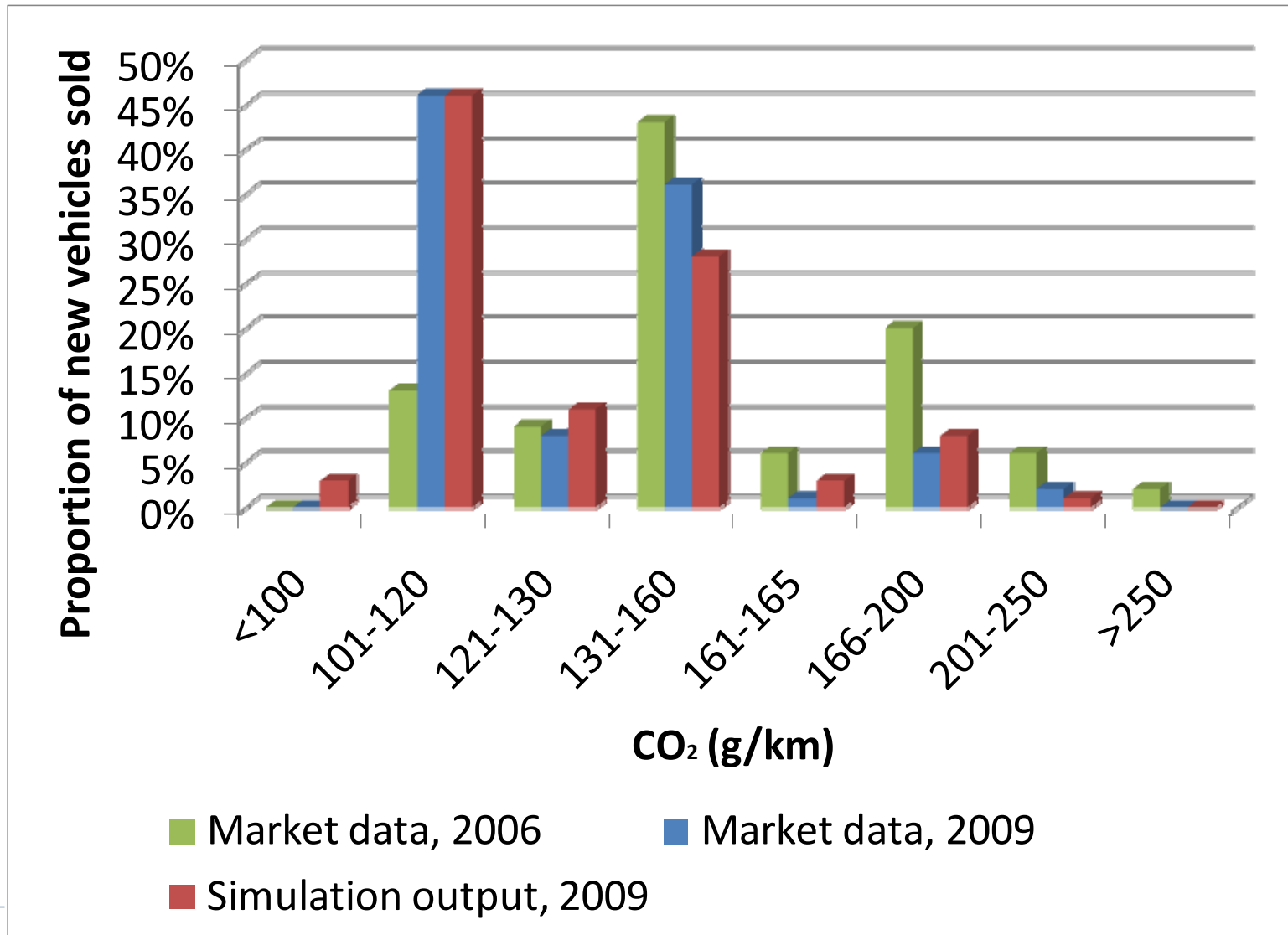
# Simulation Model Structure

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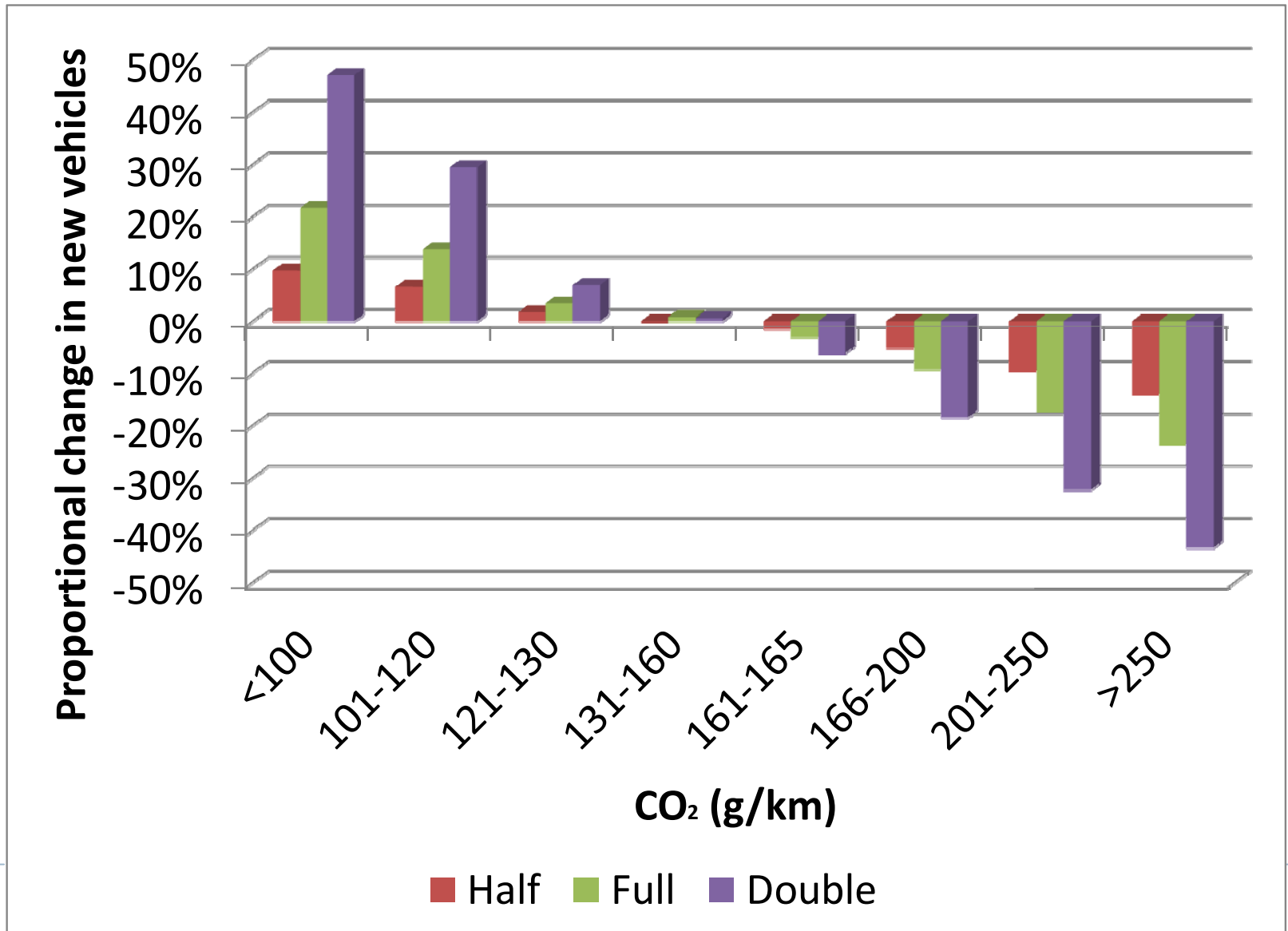
# Simulation Results

## Cross-check to market data



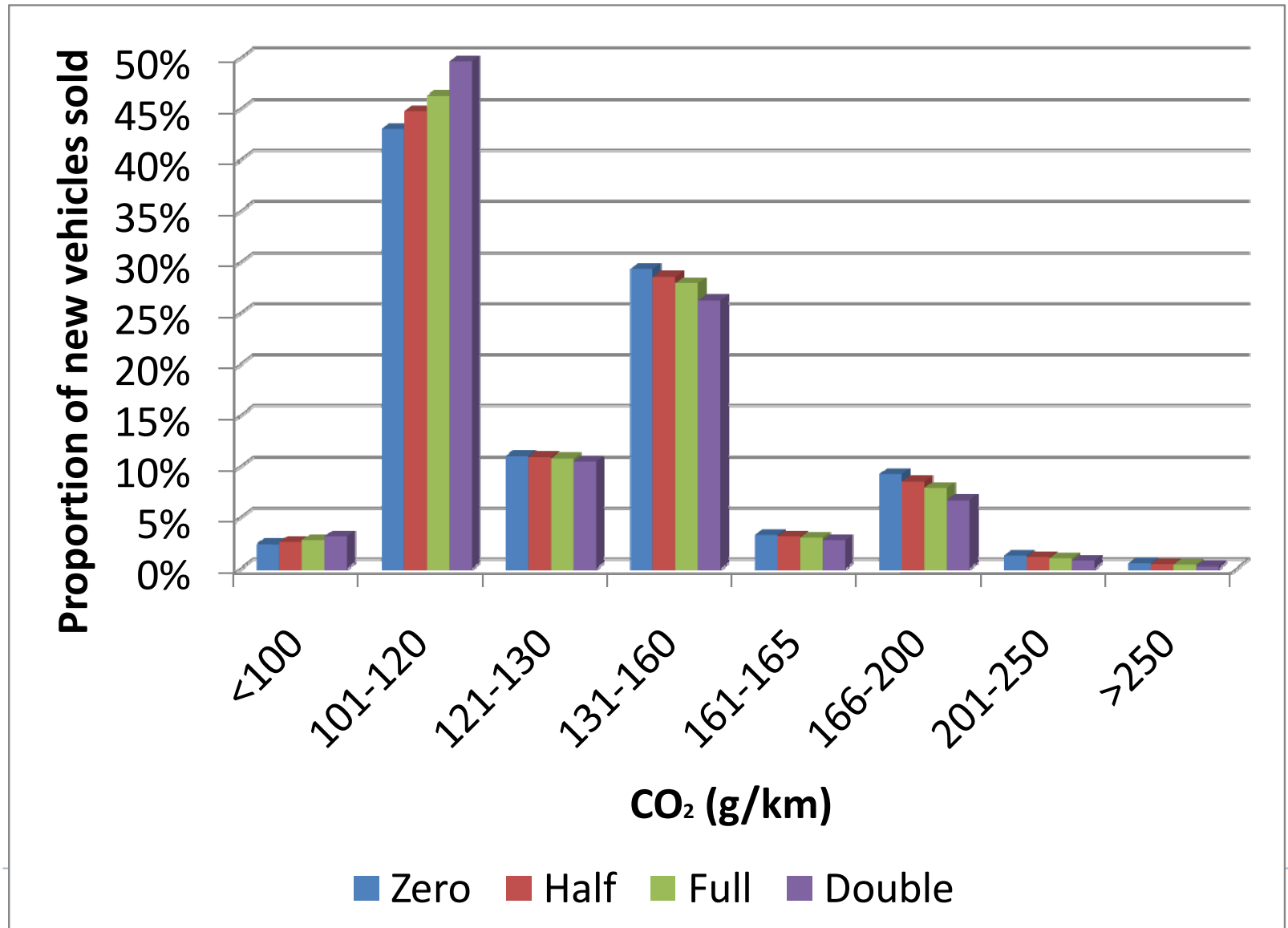
# Simulation Results

## Changing the Feebate Parameters (1)



# Simulation Results

## Changing the Feebate Parameters (2)



# Concluding Remarks

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- ▶ **Econometric vehicle choice model developed**
  - ▶ Large representative dataset
  - ▶ Sensible parameters
  - ▶ Reasonably close simulation outputs on CO<sub>2</sub> band shares
- ▶ **Useful set of simulation possibilities**
- ▶ **Some data issues**
  - ▶ INSEE data do not fully capture the exact vehicle owned
  - ▶ JATO and L'Argus data are not complete
  - ▶ No data on previous car holdings so cannot model dynamics
- ▶ **Further research would help:**
  - ▶ To explore the supply side
  - ▶ To model fuel demand



# Choice Model for One-Vehicle Households

Explanatory variable		Estimated Coefficient	Standard Error	t-statistic
1	Purchase price (€000) for households with incomes less than €16,806	-0.4048	0.0165	-24.55
2	Purchase price (€000) for households with incomes between €16,806 and €26,510	-0.2777	0.0132	-21.04
3	Purchase price (€000) for households with incomes between €26,511 and €38,870	-0.1975	0.0124	-15.95
4	Purchase price (€000) for households with incomes greater than €38,870	-0.1195	0.0116	-10.34
5	Variable cost (€/100km) for households with incomes less than or equal to €26,510	-0.2839	0.0130	-21.76
6	Variable cost (€/100km) for households with incomes between €26,511 and €38,870	-0.2559	0.0177	-14.43
7	Variable cost (€/100km) for households with incomes greater than €38,870	-0.1793	0.0186	-9.65
8	Luggage capacity (m <sup>3</sup> ) for households with at least four members	4.0370	0.3857	10.47
9	Log of the number of makes and models of the vehicle type (as a proportion of all makes and models)	1.0459	0.0168	62.18
10	Variance of price around its mean for the vehicle type	0.0131	0.0020	6.69
11	New vintage dummy	0.3991	0.1233	3.24
12	1-5 year old vintage dummy	0.1768	0.0567	3.12
13	MPV dummy	-1.8591	0.1773	-10.49
14	MPV dummy for households with at least four members	0.9590	0.2514	3.82
15	Sports car dummy	-2.4931	0.3003	-8.30
16	SUV dummy	-0.8590	0.1207	-7.11

# Choice Model for Two-Vehicle Households

Explanatory variable		Estimated Coefficient	Standard Error	t-statistic
1	Purchase price of both vehicles summed ( €000) for households with incomes less than €16,806	-0.3057	0.0241	-12.69
2	Purchase price of both vehicles summed (€000) for households with incomes between €16,806 and €26,510	-0.2642	0.0129	-20.50
3	Purchase price of both vehicles summed (€000) for households with incomes between €26,511 and €38,870	-0.2021	0.0077	-26.31
4	Purchase price of both vehicles summed (€000) for households with incomes greater than €38,870	-0.1107	0.0054	-20.66
5	Variable cost of both vehicles summed (€/100km)	-0.3162	0.0093	-33.99
6	Luggage capacity of both vehicles summed (m <sup>3</sup> ) for households with at least four members	1.3787	0.2186	6.31
7	Luggage capacity of both vehicles summed (m <sup>3</sup> ) for households with three or fewer members	1.0502	0.1708	6.15
8	Expected absolute difference in luggage capacity of both vehicles (m <sup>3</sup> ) for households with at least four members	1.4931	0.3003	4.97
9	Expected absolute difference in luggage capacity of both vehicles (m <sup>3</sup> ) for households with three or fewer members	0.6637	0.2649	2.51
10	Log of the number of pairs of makes and models in the vehicle type pair (as a proportion of all possible pairs of makes and models)	0.9749	0.0151	64.57
11	Number of new vintage vehicles in pair	0.2525	0.1705	1.48
13	Number of MPVs in pair	-1.6320	0.1484	-11.00
14	Number of MPVs in pair for households with at least four members	1.3466	0.1898	7.10
15	Number of SUVs in pair	-0.2943	0.0825	-3.57
16	Number of sports cars in pair	-1.3067	0.1533	-8.52

# Vehicle Quantity Choice Model

Explanatory variable		Estimated Coefficient	Standard Error	t-statistic
1	Log of household income (€), entering one-vehicle alternative	0.8120	0.0744	10.91
2	Log of household income (€), entering two-vehicle alternative	1.5916	0.1303	12.21
3	Number of workers in household, entering one-vehicle alternative	0.3670	0.0485	7.57
4	Number of workers in household, entering two-vehicle alternative	0.7804	0.0567	13.76
5	Log of the number of members of the household, entering two-vehicle alternative	1.2658	0.0796	15.91
6	Dummy for small town, entering one-vehicle alternative	-0.4837	0.1205	-4.01
7	Dummy for small town, entering two-vehicle alternative	-0.8631	0.1355	-6.37
8	Dummy for medium town, entering one-vehicle alternative	-0.6289	0.1208	-5.21
9	Dummy for medium town, entering two-vehicle alternative	-1.3451	0.1412	-9.53
10	Dummy for large town, entering one-vehicle alternative	-0.9337	0.1006	-9.28
11	Dummy for large town, entering two-vehicle alternative	-1.7478	0.1164	-15.02
12	Dummy for Paris, entering one-vehicle alternative	-2.0676	0.1128	-18.34
13	Dummy for Paris, entering two-vehicle alternative	-3.8671	0.1398	-27.67
14	Average utility in vehicle-type choice for one-vehicle	0.5352	0.0542	9.87
15	Average utility in vehicle-type choice for two-vehicles	0.9440	0.1011	9.33
16	Constant for one-vehicle alternative	-4.1170	0.8767	-4.70
17	Constant for two-vehicle alternative	-9.0976	1.9056	-4.77