Vehicle Tax Design and Car Purchase Choices: A Case Study of Ireland

Ivan Petrov [1] (ivan.petrov@ucdconnect.ie), Lisa Ryan [1] (lisa.ryan@ucd.ie)

School of Economics and Energy Institute – University College Dublin [1]

INTRODUCTION

On the 1st of July 2008, the motor taxation regime in Ireland underwent a complete overhaul. Both Vehicle Registration Tax (VRT) and Annual Motor Tax (AMT) switched from being engine capacity based, to being based on carbon dioxide (CO_2) emissions ratings per kilometre. The goal behind this action was to reduce CO_2 emissions by aligning one of the main externalities associated with passenger car use with the taxation system. We attempt to provide evidence on the effectiveness of this policy change.

Objectives

The purpose of this paper is to analyse the impact of the 2008 (and subsequent) motor taxation policy changes in the Republic of Ireland on the purchasing patterns of new vehicles.

We do this in two ways. Firstly, we look at the impact of the tax regime changes on the average CO_2 rating of newly registered passenger cars in Ireland on a monthly basis. Secondly, we look a little deeper into the underlying cause of this effect by analysing how the tax regime change impacted vehicle purchasing patterns in terms of vehicle fuel type.

METHODOLOGY

The strategy we use to get an estimate of the magnitude of the effect of the policy changes on average CO_2 emissions and diesel share is a difference in differences quasi-experimental design, using the UK as our comparison case. As per Wing, Simon, & Bello-Gomez (2018), the basic form for a difference-in-differences analysis with multiple periods and countries in a regression framework is as follows:

$$Y_{st} = \gamma_s + \lambda_t + \delta D_{st} + \epsilon_{st}$$

In the above, γ_s is the state (country) fixed effect and λ_t is the time fixed effect. D_{st} is an interaction term of treated units after the treatment date (i.e. $IRL_s \cdot d_t$ where d_t is a dummy variable which switches from 0 to 1 at the first policy introduction date). The results of the above are presented in column (1) of tables 2 and 3.

For our second specification, we estimate the effect of all of the interim policy changes which occurred in Ireland between 2008 and 2013. We therefore expand the equation above to include interaction terms for each of the interim policy changes. Results presented in column (2) of tables 3 and 4.

For our third specification, we control for state specific covariates which vary over time and which may influence vehicle purchasing decisions, such as household income and fuel prices. The results are presented in column (3) of tables 3 and 4.

Finally, as a robustness check, we also include a state-specific linear trend (as per Angrist & Pischke, 2008). The Results are presented in column (4) of tables 2 and 3.

RESULTS

Table 1: Timeline of Annual Motor Tax Rate (AMT) Changes – Republic of Ireland

	1st July 2008 (i)			1st Jan 2009 (ii)				1st Jan 2012 (iii)				1st January 2013 (iv)				
Category	Lower Limit (>)	Upper Limit (<=)	Rate (annual)	Lower Limit (>)	Upper Limit (<=)	Rate (annual)	% Change	Lower Limit (>)	Upper Limit (<=)	Rate (annual)	% Change	Category	Lower Limit (>)	Upper Limit (<=)	Rate (annual)	% Change
A	0	120	100	0	120	104	4%	0	120	160	54%	A0	0	0	120	-25%
												A1	1	80	170	6%
												A2	80	100	180	13%
												A3	100	110	190	19%
												A4	110	120	200	25%
B	120	140	150	120	140	156	4%	120	140	225	44%	B1	120	130	270	20%
												B2	130	140	280	24%
C	140	155	290	140	155	302	4%	140	155	330	9%	C	140	155	390	18%
D	155	170	430	155	170	447	4%	155	170	481	8%	D	155	170	570	19%
E	170	190	600	170	190	630	5%	170	190	677	7%	E	170	190	750	11%
F	190	225	1000	190	225	1050	5%	190	225	1129	8%	F	190	225	1200	6%
G	225		2000	225		2100	5%	225		2258	8%	G	225		2350	4%

Figure 1: Average CO2 Emissions Ratings per Month

Figure 1: Average CO2 Emissions Ratings per Month (Scrappage Scheme — Ireland — UK)
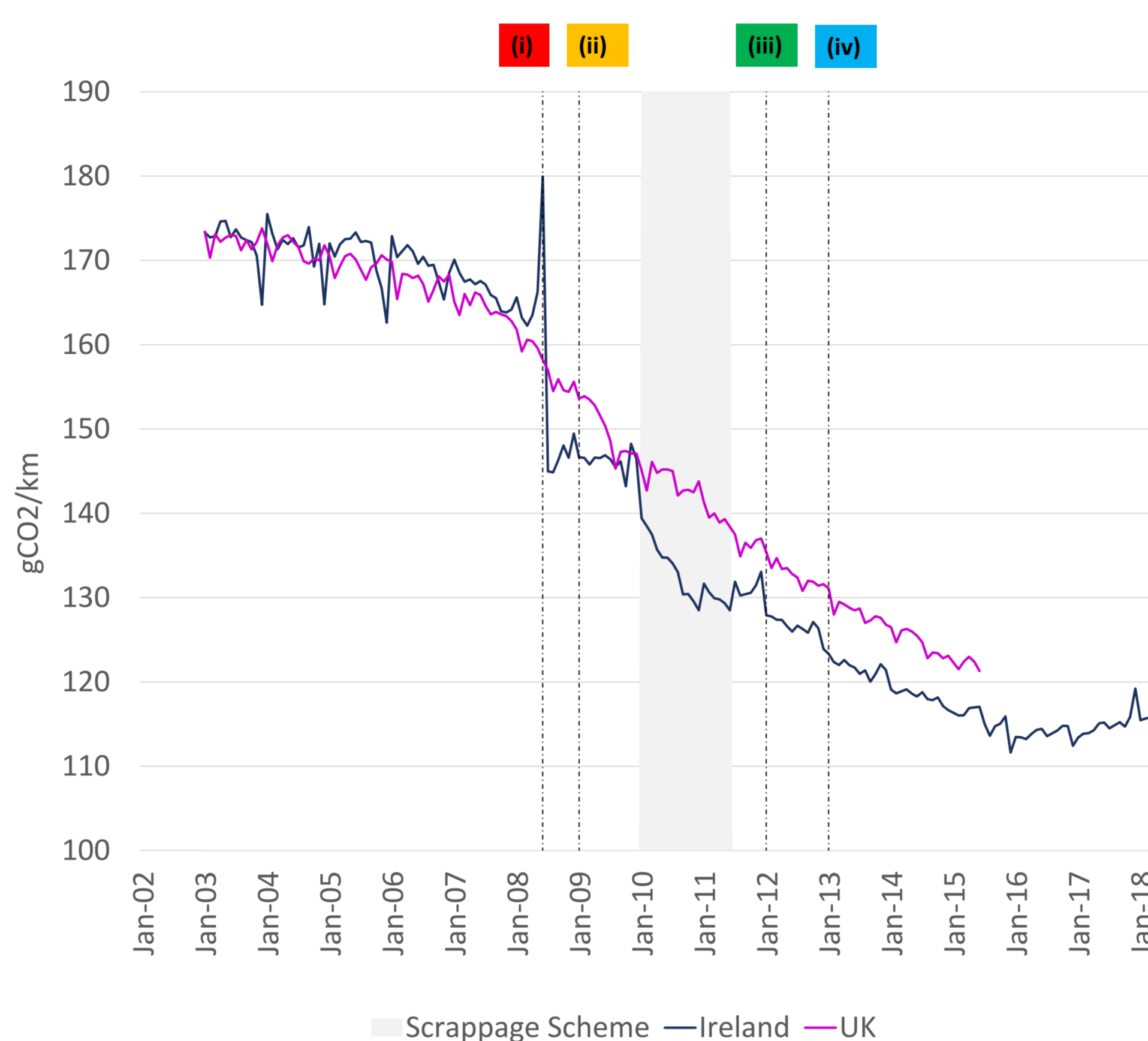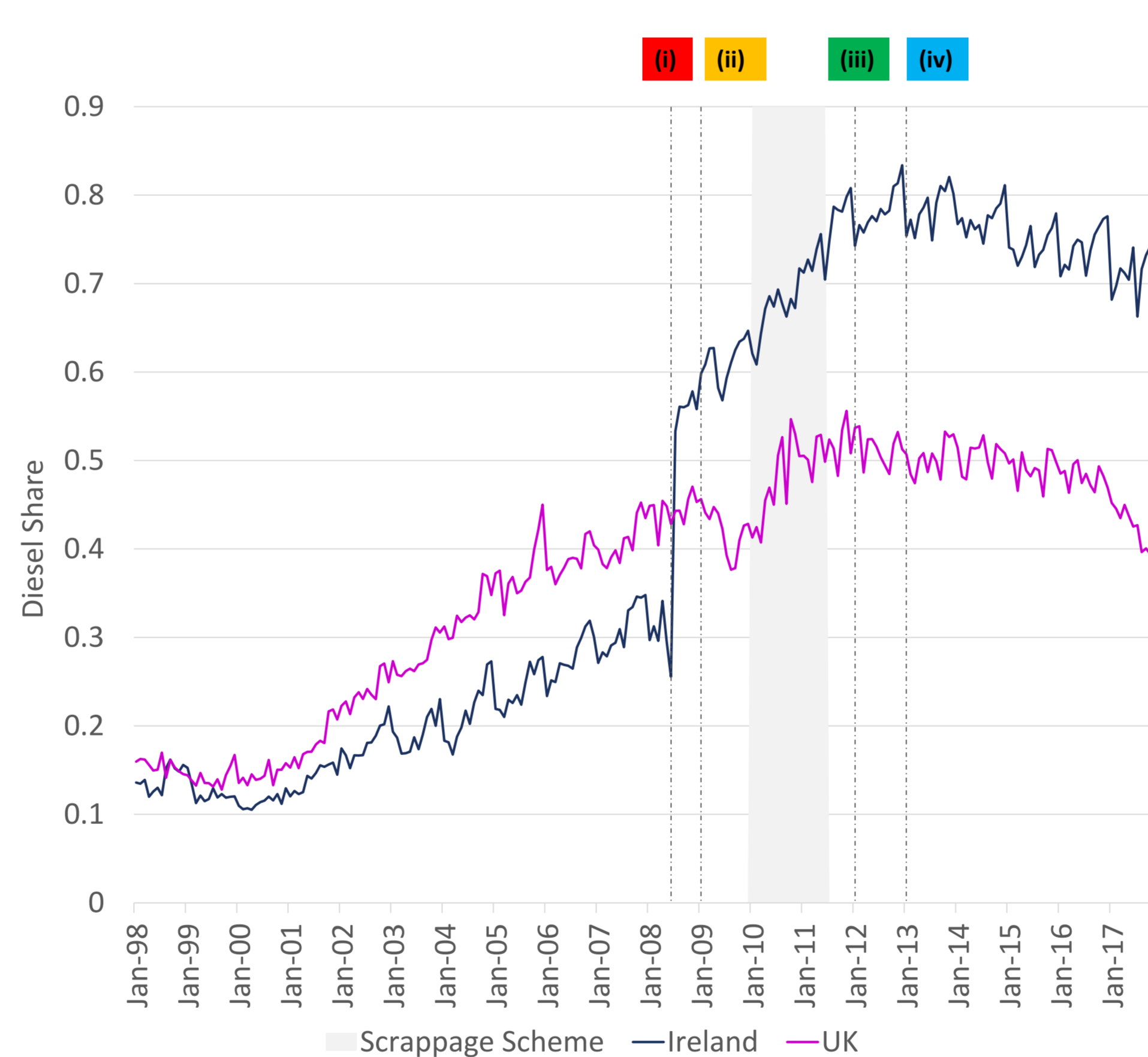
Table 2: Diff in Diff Results: CO2 Emissions Ratings

	(1)	(2)	(3)	(4)	
Initial Policy Change (2008)	-8.434 *** (0.531)	-10.287 *** (1.232)	-9.173 *** (1.576)	-11.095 *** (1.713)	(i)
Interim Policy Change (2009)		4.484 *** (2.591)	4.671 *** (1.518)	4.119 *** (1.503)	(ii)
Scrappage Scheme (2010 -2011)		-5.806 *** (0.963)	-6.556 *** (1.040)	-6.257 *** (1.026)	
Interim Policy Change (2012)		-2.046 * (1.077)	-2.495 ** (1.111)	-3.385 *** (1.142)	(iii)
Final Policy Change (2013)		-0.124 (0.987)	0.125 (1.007)	-0.966 (1.074)	(iv)
Control Variables	No	No	Yes	Yes	
State Specific Trend	No	No	No	Yes	
Adjusted R	0.987	0.989	0.990	0.990	

*** Statistically significant at p<0.01
** Statistically significant at p<0.05
* Statistically significant at p<0.1

Figure 2: Diesel Share of Passenger Car Registrations

Figure 2: Diesel Share of Passenger Car Registrations (Scrappage Scheme — Ireland — UK)

Table 3: Diff in Diff Results: Diesel Share

	(1)	(2)	(3)	(4)	
Initial Policy (2008)	0.354 *** (0.007)	0.220 *** (0.014)	0.181 *** (0.015)	0.187 *** (0.016)	(i)
Interim Policy Change A (2009)		0.106 *** (0.015)	0.082 *** (0.016)	0.083 *** (0.016)	(ii)
Scrappage Scheme (2010 -2011)		-0.014 (0.011)	-0.021 * (0.011)	-0.023 ** (0.011)	
Interim Policy Change B (2012)		0.052 *** (0.012)	0.039 *** (0.012)	0.043 *** (0.012)	(iii)
Final Policy Change (2013)		0.005 (0.010)	-0.012 (0.010)	-0.005 (0.011)	(iv)
Control Variables	No	No	Yes	Yes	
State Specific Trend	No	No	No	Yes	
Adjusted R^2	0.967	0.984	0.986	0.986	

*** Statistically significant at p<0.01
** Statistically significant at p<0.05
* Statistically significant at p<0.1

CONCLUSIONS

The above findings suggest that the change in VRT and AMT in Ireland from engine capacity based to CO_2 emissions based in 2008 resulted in a decrease in the average CO_2 rating of newly registered passenger cars. As shown by our second estimation however, this decrease was driven by a shift from petrol powered vehicles to diesel powered vehicles which have lower rated CO_2 emissions. An extension of this study will be to obtain micro-level data from the UK in order to improve the precision of the standard errors estimated above. Further, more detailed analysis on the immediate behavioural impacts (such as the type /timing of vehicles purchased) which result from the policy changes is also necessary.