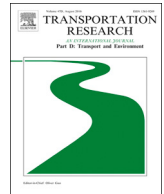


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# Transportation Research Part D

journal homepage: [www.elsevier.com/locate/trd](http://www.elsevier.com/locate/trd)

## Fuel price differentials and car ownership: A spatial analysis of diesel cars in Northern Ireland



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### ARTICLE INFO

#### Keywords:

Diesel  
Car ownership  
Vehicle stock model  
Fuel tourism  
Spatial arbitrage

### ABSTRACT

Car fleets across much of Europe have undergone a process of dieselisation over the past 20 years. Understanding the factors driving this process is therefore important for sustainable transport policy, with implications for how governments steer their national car fleets towards ultra-low emission vehicles in the future. At a general level, this paper contributes to this wider body of work which aims to understand the factors which led to the transition from petrol to diesel. Specifically, the paper investigates whether the availability of relatively cheap diesel fuel in the Republic of Ireland affected the rate of diesel car ownership in Northern Ireland. A geographic approach is used, which involves generating spatial variables measuring nearness to the Republic of Ireland and comparing these with the proportion of the local car stock that is fuelled by diesel. A series of spatial regression models are specified to determine if this association between nearness to the Republic and diesel ownership persists after accounting for the effect of socio-economic, travel, and household characteristics. The results support the hypothesis that the availability of cheaper fuel in the Republic of Ireland is not only generating fuel-tourism, but is also affecting the structure of the car fleet registered in Northern Ireland. The findings are relevant beyond the case study and imply that the structure of a country's car fleet is not only dependent on domestic policies, but is also affected by the policies of neighbouring countries.

### 1. Introduction

Since the end of the twentieth century, the European car fleet has undergone a process of dieselisation, whereby diesel engines have progressed from existing in a market niche to having parity with petrol engines (Schipper and Fulton, 2013). This transition was motivated by a host of factors including the ability of diesel engines to offer reduced carbon dioxide emission factors and increased fuel economy compared to petrol engines as well as a desire to establish a larger market for diesel fuels. Recently, the popularity of diesel engines has come under scrutiny, due in part to increased concerns regarding air quality levels and the disparity between official emission factors for local air pollutants generated by diesel engines and those observed during real-world driving conditions (Brand, 2016). This situation has led to certain urban areas proposing bans on the use of diesel cars and calls for a shift away from diesel engines throughout the car fleet.

Such a shift could be facilitated by a set of government policies which push drivers away from diesel cars (e.g. the introduction of Clean Air Zones and surcharges on diesel fuel tax) and pull drivers towards low emission vehicles (e.g. vehicle scrappage schemes and purchase incentives) (Brand et al., 2013). The efficacy of such a strategy is contingent on the ability of the government to exert

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<https://doi.org/10.1016/j.trd.2018.07.008>

control over the structure of the car stock. However, there are situations where the sovereignty of this control is diminished due to the policies being deployed by exogenous agents that also affect the structure of the car stock. A version of such a situation is where the domestic policy of one country extends into another, which may generate effects that are not aligned to the priorities of the host country.

This paper presents a case study of such a situation by examining how fiscal measures enacted in the Republic of Ireland may have affected the structure of the car fleet in Northern Ireland. Historically, the fuel tax on road diesel in the Republic has been lower than that in effect in Northern Ireland, which has led to diesel in the Republic having been as much as 30 pence (0.3 GBP) per litre cheaper since 2000. This price differential represents a spatial arbitrage opportunity, where drivers in one area (i.e. Northern Ireland) can derive an advantage (i.e. lowering their costs) from purchasing diesel in a nearby area (i.e. the Republic). The occurrence of fuel tourism across the Irish border is a known issue (Dineen et al., 2014; Kennedy et al., 2017), with 22.8% of the diesel fuel sold in the Republic estimated as being consumed in Northern Ireland. However, no work to date has examined if this availability of cheaper diesel across the border has motivated the purchase of diesel cars in Northern Ireland. This research aims to address this gap, by examining the geographical variation in diesel car ownership across Northern Ireland. The specific hypothesis examined in this research is that the effect of this price differential in diesel fuel on the registration of diesel cars diminishes as distance to the Republic increases (i.e. a distance decay effect).

## 2. Background

### 2.1. Spatial arbitrage

Countries often employ fiscal measures to manage the demand for a good and raise tax revenue from its sale. In certain situations, neighbouring countries may follow different fiscal strategies, which leads to disparities in the sale price faced by consumers in the different countries. If the good in question is homogenous (i.e. its qualities do not differ between countries), this could generate a spatial arbitrage opportunity. Under such an opportunity, consumers of a good in a country which has a higher sales price may reduce the costs they face by travelling to the neighbouring country where the sales price is lower to make their purchase. Spatial arbitrage opportunities have been extensively evaluated for such goods as tobacco and alcohol (Leal et al., 2010). The phenomenon also extends to the transport sector, where the price of fuel faced by both private and freight consumers (Transport and Environment, 2011) in neighbouring countries or regions can be sufficiently different to induce what is often referred to as fuel-tourism behaviour (Rietveld et al., 2001; Banfi et al., 2005; Rietveld et al., 2005; Leal et al., 2009; Romero-Jordán et al., 2013). Such behaviour can generate several adverse consequences, such as reductions in tax and fuel station revenue in the country with the higher price level as well as increasing car travel. To date, no research has considered whether the occurrence of fuel tourism also affects the structure of the car fleet. The study presented in this paper addresses this gap and is likely to be of international relevance given the common occurrence of fuel price differentials amongst neighbouring countries.

### 2.2. Dieselisation

The share of diesel cars in new registrations across the European Union (EU) increased from 23.5% in 1995 to 55.7% in 2011 (Association des Constructeurs Européens d'Automobiles, 2017). A similar, albeit delayed, trend was also observed in the United Kingdom (UK), where diesel cars represented less than 20% of new registrations in 2001, with the market expanding to over 50% of new registrations in 2012 (Fig. 1).

A combination of factors, linked to improvements in the technical performance of diesel engines and preferential taxation regimes for diesel fuel, contributed to this shift in car fuel type (Schipper et al., 2002; Mazzi and Dowlatabadi, 2007; Kågeson, 2013). Expectations were that increased penetration of these more technically efficient diesel cars into national fleets would have benefits for energy security and climate change mitigation (Bonilla, 2009; Tovar, 2011). However, these expected benefits have been eroded by increases to diesel car horsepower and mass (Zachariadis, 2013; Schipper and Fulton, 2009, 2013), confounded by diesel cars continuing to be driven more than petrol cars (Schipper and Fulton, 2013) and an increasing gap between official emission factors and those observed during real-world driving conditions (Carslaw et al., 2011; Moody and Tate, 2017). The shift towards diesel cars has simultaneously led to expansions in the quantity of local pollutants (e.g. particulate matter and nitrogen oxides) emitted from car use (Mazzi and Dowlatabadi, 2007), with the UK's Royal College of Physicians (2016) estimating that 40,000 deaths per year can be attributed to the inhalation of these compounds.

Due to these implications, the anticipated benefits of the shift to diesel have generally failed to materialise, which raises questions about what value if any the process of dieselisation has generated. Through an integrated simulation model of the UK transport system, Brand (2016) illustrates how the introduction of a purchase tax on new diesel cars alongside a widespread commitment to supporting Electric Vehicles could reverse this process and promote a shift to a low-emission fleet. However, the effectiveness of these measures relies on the government having control over the factors which effect fleet composition. The case study presented in this paper demonstrates that such control may be diluted by policies enacted in neighbouring jurisdictions.

### 2.3. The situation in Northern Ireland

Northern Ireland represents the only nation of the UK that has a land border with another country, being the Republic of Ireland to the south and west. At the time of writing, fuel duty in Northern Ireland is 57.95 pence per litre for diesel plus a 20% value added

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