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# **Effectiveness of car scrappage schemes: lessons from Slovakia and other European countries**

## ***IREF WORKING PAPER***

Miroslav Svoboda<sup>1</sup>, Michael Fanta<sup>2</sup>, Jan Mošovský<sup>3</sup>

### **Abstract**

This study aims to investigate the effectiveness of car scrappage schemes implemented in the European Union (EU) during the economic crisis of 2009. The study uses a synthetic control variable and a difference-in-differences method to evaluate these policies. Using monthly data on new passenger car registrations in European countries, as well as unique detailed registration and deregistration data for Slovakia and the Czech Republic, the study examines the impact of the schemes. The results show that the impact of scrappage schemes varies across countries, with statistically significant effects observed in Germany and Slovakia, followed by Greece and Italy, albeit limited in some aspects. The results of the study underline the need for careful policy design and show that the effectiveness of car scrappage schemes goes beyond the level of premiums or budget allocations. It is also influenced by other elements such as the duration of the scheme, the overarching policy environment and the novelty of the implementation strategies.

**Keywords:** Car scrappage schemes, synthetic control method, difference-in-differences

**JEL Classification:** H23, C21, R48

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# 1. Introduction

Car scrappage schemes have been implemented in the past in several countries, including the largest economies such as Germany, France, Italy, the United Kingdom, the United States or Japan, as a means of stimulating new car sales, supporting socio-economic development and promoting environmental sustainability. The basic premise of a scrappage scheme is that individuals are given a financial incentive to scrap their old, less fuel-efficient vehicles and buy new, more fuel-efficient and environmentally friendly ones. The government often contributes to this incentive with some form of fiscal subsidy.

In times of economic recession, scrappage schemes have been used as a means of stimulating demand in the automotive industry, which is an important industrial sector in many economies. During the economic depression of 2008–2009, 14 European countries implemented scrappage schemes and there may be a growing expectation that the current situation could lead to similar government support. The combination of the effects of the COVID-19 pandemic, the energy crisis, the need to meet strategic European environmental targets (in particular the Green Deal and Fit for 55) and the shortage of components in the automotive industry make the prospect of new government subsidies or incentives in the coming years even more likely.

While scrappage schemes have been successful in stimulating new car sales and promoting environmental sustainability, they have also been the subject of criticism. Some argue that they simply encourage people to buy new cars when their old ones are still perfectly serviceable, leading to unnecessary waste. Others argue that the government subsidy could be better spent on other environmental initiatives.

The implementation and effectiveness of car scrappage schemes continues to provide a unique opportunity for in-depth economic research. Despite existing studies on this topic, most of them have focused on individual countries or a selected group of them, limiting the overall understanding of the impact of these schemes across the EU. Against this background, this study fills a significant gap in the literature by providing a comprehensive analysis of all EU countries that have implemented car scrappage schemes. A distinguishing feature of our study is the careful identification of the periods during which these schemes were active, the different forms they took and the budgets allocated to them.

In addition, this research introduces an extended approach to analysis in this area by combining the synthetic control variable with the difference-in-differences method. This combination of analytical methods, rarely used together in previous studies, adds robustness to our findings and enhances the nuanced understanding of the effects of the schemes.

Finally, our research makes a unique contribution by focusing on the case of Slovakia. We have secured access to highly detailed data not previously used in such studies, allowing for an in-depth analysis of the impact and effectiveness of the scrappage scheme in this specific context. The findings from this concentrated case study will not only shed light on the Slovak

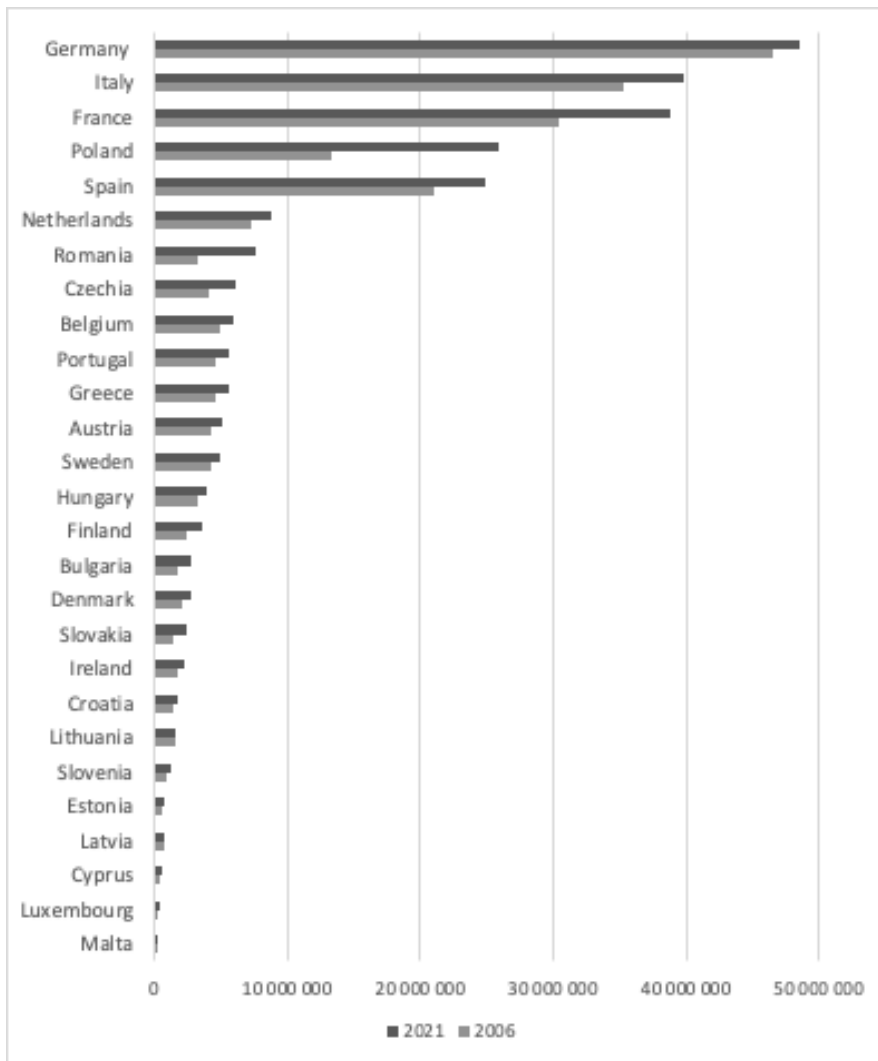
experience, but will also contribute to a broader understanding of the benefits and limitations of scrappage schemes across the EU.

## **2. Brief overview of the vehicle fleet development in the EU**

Before analysing the car scrappage scheme itself, the authors consider it important to take a brief look at the evolution of the composition of the car fleet in the EU in order to put the issue in its overall context. As can be seen in this chapter and in a number of figures, the total passenger car fleet in the European Union (EU) has changed significantly between 2005 and 2021.

According to the Eurostat database (2023), the number of registered passenger cars in the EU increased from around 203 million in 2006 to more than 253 million in 2021 (Figure 1). The total number of passenger cars increased in all EU countries, with the relatively smallest increase between 2005 and 2021 in Latvia (+2%) or Germany (+5%). On the other hand, the largest increases were observed, for example, in Romania (+126%) or Poland (+110%). However, the composition of the fleet has changed significantly during this period (Barjoveanu et al., 2022).

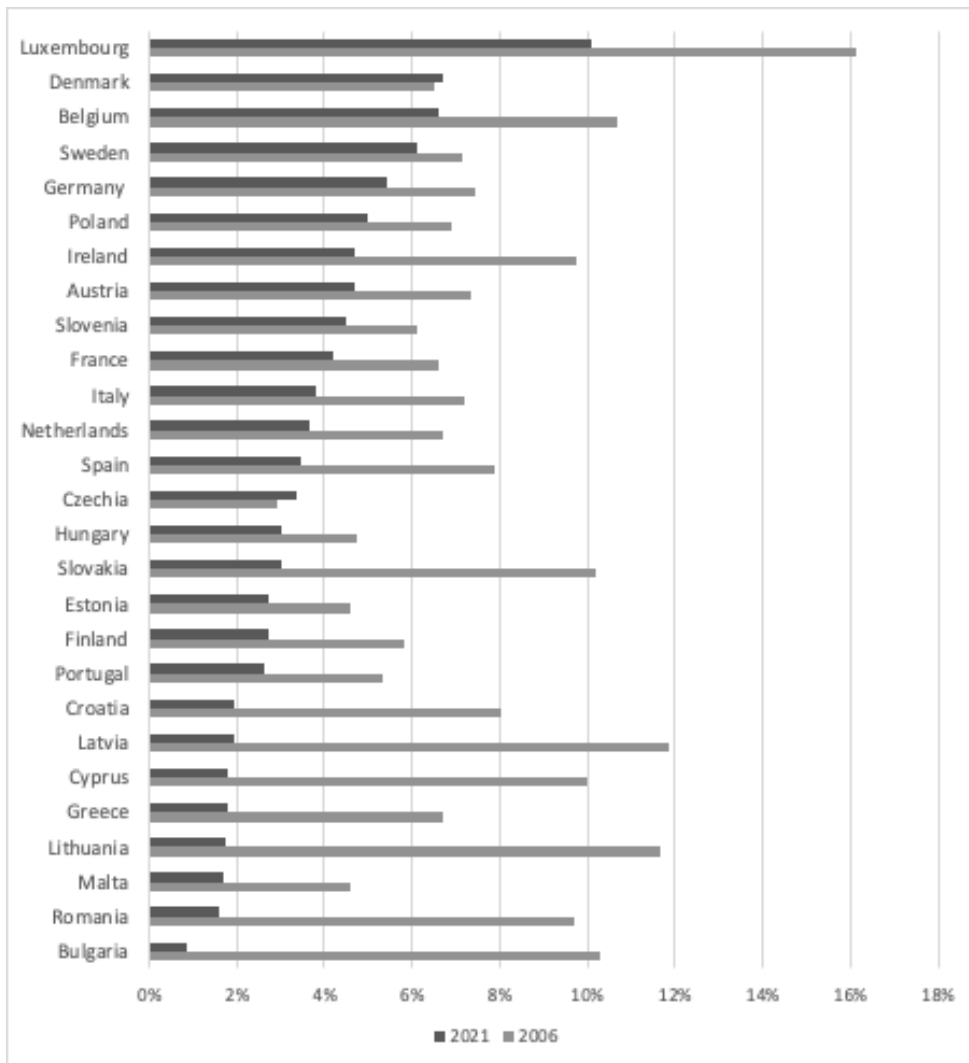
**Figure 1: Passenger car fleet size across EU, change between 2006 and 2021**



Source: Eurostat, 2023

The renewal rate of passenger cars across the EU has been a key factor in the changes observed in the composition of the total fleet. The renewal rate refers to the rate at which older vehicles are replaced by newer ones, which can have important implications for the environment and the economy as a whole. However, according to data from the European Environment Agency (EEA) (2022) and Eurostat (2023), the average age of passenger cars in the EU has increased, suggesting that the renewal rate of passenger cars has slowed down. Indeed, as shown in Figure 2, the difference in the renewal rate of passenger cars between 2006 and 2021 is significant in almost all European countries.

**Figure 2: Renewal rate of passenger cars, change between 2005 and 2021\***



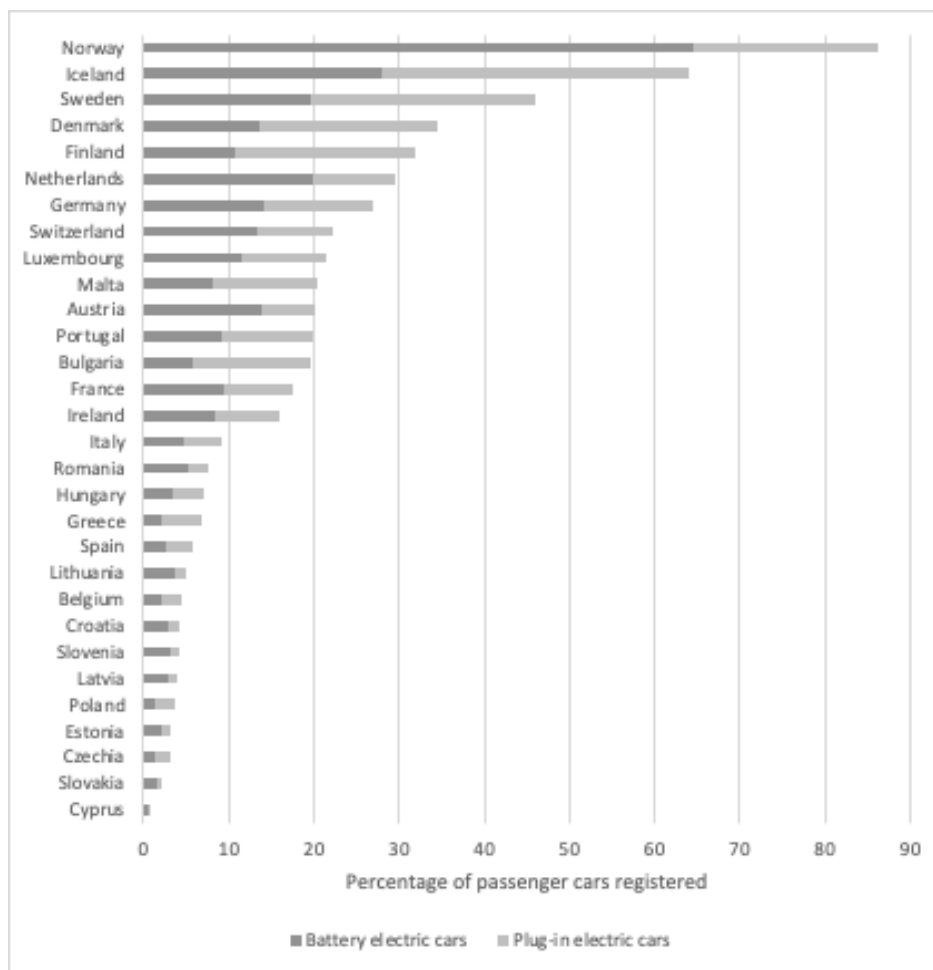
Source: Eurostat, 2023

\* The renewal rate was calculated as a ratio between the number of newly registered passenger cars and the total number of passenger cars.

Therefore, a slower renewal rate of passenger cars could have several negative effects on the environment and public health, as older vehicles tend to be less fuel efficient and emit more pollutants than newer ones. However, the increasing share of electric and hybrid vehicles in the fleet, as well as the decreasing share of diesel vehicles, may partially offset these negative effects (Tan et al., 2018; Held et al., 2021).

Across Europe, the uptake of electric cars and vans saw a significant increase in 2021. With electric car registrations reaching nearly 1,729,000, up from 1,061,000 the previous year, the share of electric cars in total new car registrations rose from 10.7% in 2020 to 17.8% in 2021 (EEA, 2022). The highest shares of electric cars in total new registrations are observed in Norway, Iceland and Sweden, which are also the countries with the highest shares of electric cars in their new car fleets (EEA, 2022).

**Figure 3: Newly registered electric vehicles (2021)\***



Source: EEA, 2022

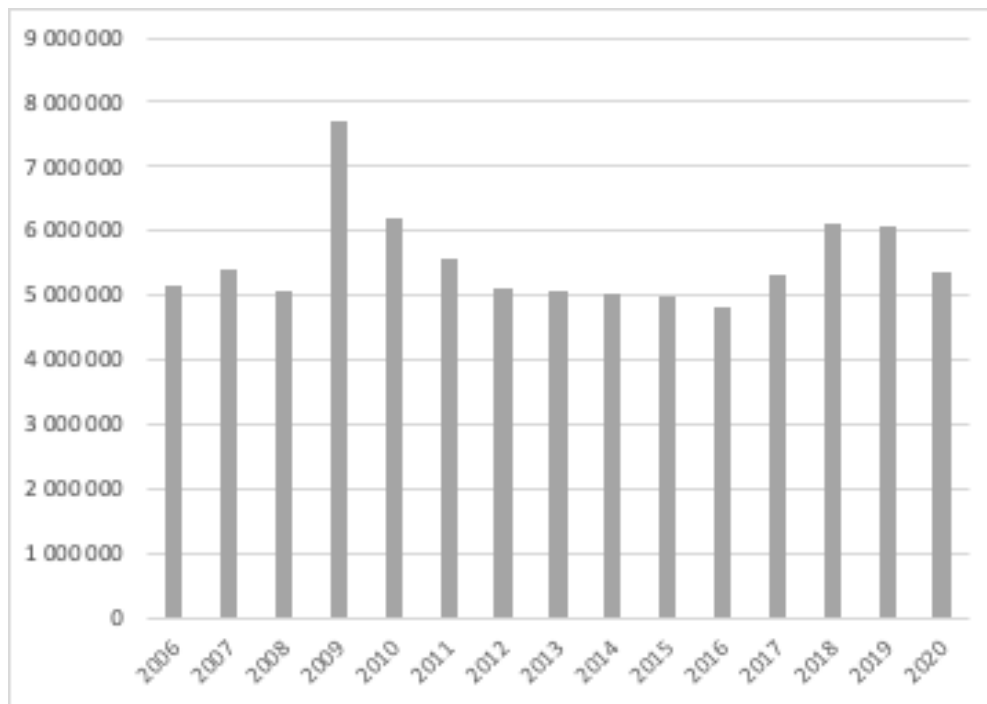
\* Share of electric cars refers to electric car registrations as a percentage of new car registrations.

The above mentioned context, together with the ever evolving legislative standards aimed at environmental protection, ultimately have an impact on various indicators, including the emissions produced (Helmerts et al., 2019). Following a modest rise during the period of 2017–2019, the average CO<sub>2</sub> emissions of new passenger cars registered in Europe plummeted by 12% in 2020. Thus, between 2006 and 2020, the average CO<sub>2</sub> emissions of new passenger cars fell by almost 33% (EEA, 2022). However, achieving the proposed goal of zero emissions for all new cars in the future will require sustained reductions in emissions in the years to come (Harvey, 2018).

The number of passenger cars scrapped across the EU is another important indicator to track as it can provide insights into the development, sustainability and environmental impact of the automotive industry (D’Adamo, Gastaldi & Rosa, 2020). The total number of end-of-life vehicles in the EU was estimated at 5.4 million in 2020 (including passenger cars, vans and other light commercial vehicles). This represents a decrease of 10.5% compared to the previous year, following two consecutive years of strong increases from 4.8 million in 2016 to 5.3 million in 2017 and 6.1 million in 2018. Despite these recent fluctuations, the number

of end-of-life vehicles recorded in 2018 was still lower than the level recorded in 2009, when 7.7 million such vehicles were reported (Eurostat, 2023).

**Figure 4: Number of end-of-life vehicles in the EU**



Source: Eurostat, 2023

However, the main reason for the record levels in 2009 is government scrapping incentives. In 2009, several countries introduced short-term government subsidies for scrapping schemes to incentivise the dismantling of older vehicles during the financial crisis (Jiménez, Perdiguero & García, 2016). Specifically, three EU member states implemented scrapping schemes in 2008, twelve countries were active in 2009 and one in 2010 (Eurostat, 2023). However, some countries have applied these support schemes for a longer period (see below).

### **3. Rationale behind scrapping schemes**

#### **3.1 Car scrapping schemes in the context of economic depression in 2009**

A highly significant and contentious economic debate revolves around the effectiveness of government fiscal intervention in stimulating economic activity. This issue has come under increased scrutiny during the economic recession of 2009, with proponents of Keynesian economics arguing for immediate and substantial fiscal intervention. Conversely, there are economists who hold the opposite view, arguing that such a stimulus is either irrelevant or harmful (Mian & Sufi, 2012).

Nevertheless, the global economic downturn of 2009 had a profound impact on the automotive industry (among others), with sales plummeting and many manufacturers



struggling to stay afloat (Sturgeon & Van Biesebroeck, 2010; Pavlínek, 2015). In response, several EU countries introduced scrappage schemes to stimulate demand for new vehicles and support their domestic automotive industries. These schemes typically offered consumers a financial incentive to trade in their old, more polluting cars for new, more efficient models, with the government subsidising part of the overall cost (Brand, Anable & Tran, 2013; Laborda & Moral, 2019).

As mentioned above, one of the primary goals of scrappage schemes from the government's perspective was to stimulate demand for new vehicles and support their domestic automotive industries during periods of economic uncertainty or recession. By offering financial incentives to consumers to trade in their old vehicles for newer and more efficient models, governments aim to encourage spending on new cars, which can help to boost the economy as a whole (Böckers, Heimeshoff & Müller, 2012). Additionally, scrappage schemes aimed at helping to support jobs in the automotive industry and the wider supply chain, which can be vital for local economies that are heavily dependent on these sectors (Wang et al., 2014).

In addition to these economic objectives, many governments have also introduced scrappage schemes with environmental objectives in mind. By incentivising the replacement of old, inefficient cars with newer, cleaner models, governments aim to reduce emissions of pollutants such as carbon dioxide and nitrogen oxides (Lelli et al., 2010; Van Wee, De Jong, & Nijland, 2011). Scrappage schemes could then also help to encourage the adoption of newer, cleaner technologies, such as electric and hybrid vehicles, which can further support climate goals and reduce the overall environmental impact of the automotive industry (Kagawa et al., 2013; Posada et al., 2015).

Another related effect of scrappage schemes could be an increase in vehicle and road safety. This is due to several factors, including the fact that older vehicles often lack modern safety features such as anti-lock braking systems, electronic stability control and advanced airbag systems (Fausto & Tefft, 2018; Török, 2020). Therefore, support schemes for fleet renewal have the potential to improve road safety (OECD/ITF, 2011).

## **3.2 Effectiveness of car scrappage schemes**

Overall, the objectives of scrappage schemes can be multifaceted, with governments seeking to achieve a range of economic and environmental objectives through their implementation. However, the success of these schemes can depend on a number of factors, including their design, implementation and the wider economic and political context in which they are implemented. Similarly, communication by national institutions to the public about the primary objectives and presumed benefits of these schemes has varied (Aldred & Tepe, 2011).

### **Stimulation of demand for new vehicles**

Previous research suggests that the impact of car scrappage schemes on the automotive industry varies, depending on the specific scheme and the country. Cantos-Sánchez et al. (2018) found that Spain's 2009 car scrappage scheme increased the likelihood of purchasing

a new car, but reduced the average expenditure on the new vehicle. Moreover, the scheme had a neutral effect on household welfare. Marin & Zoboli (2020) and Romano & Scandurra (2012) found that the Italian car scrappage scheme of 2009 was very successful in promoting the replacement of older cars. Böckers, Heimeshoff & Müller (2012) also confirmed that the German scheme was successful in creating additional demand for new cars during the policy period (especially for two specific market segments).

Grigolon et al. (2016), who analysed eight European countries, found that scrappage schemes played a significant role in stabilising total car sales in 2009. These schemes helped to prevent a 30.5% decline in total car sales in countries with schemes specifically targeting low emission vehicles, and a 29.0% decline in countries with non-targeted schemes. The results of Lüth (2021) show that while the removal of subsidies led to a shift in consumer behaviour over time, the overall impact on car registrations remained positive in all OECD countries studied, except for the UK, where any increase in sales was completely offset by a subsequent decline in consumer enthusiasm.

However, this fiscal stimulus also affected the pricing mechanisms in the car market. Kaul, Pfeifer & Witte (2016), who evaluated the scrappage scheme in Germany, found that the average prices of vehicles actually fell for buyers who received subsidies compared to those who did not, suggesting that subsidised customers ended up benefiting by more than the amount of the subsidy. But for more expensive cars, subsidised buyers received large additional discounts on top of the government premium. On the other hand, Jiménez, Perdiguero & García (2016) found that manufacturers increased vehicle prices by an average of €600 in Spain.

Significant experience can also be found in the US, where Hoekstra, Puller & West (2017) found that around 60% of subsidies went to households that would have purchased the car regardless of the two-month scrappage scheme. These findings are in line with Li et al. (2013), who found that 45% of scrappage spending went to consumers who would have bought a new car anyway.

## **Environmental impacts**

Similarly, there is considerable disagreement as to whether scrappage schemes have made a significant contribution to reducing emissions. A comprehensive literature review by Van Wee, De Jong & Nijland (2011) concludes that the indirect impact on the used car market, the impact on car use and emissions from use, and life cycle emissions have not been sufficiently taken into account. The impact on emissions is small and temporary. The cost-effectiveness of scrappage schemes is often unsatisfactory, while the most favourable cost-effectiveness results are observed in densely populated urban areas and only when cars without emission control technologies are scrapped.

A similar conclusion was reached by Lelli et al. (2010), who mentioned that the evolution of CO<sub>2</sub> emissions over the whole vehicle life cycle is neutral with respect to the acceleration of car replacement stimulated by scrappage schemes, as well as Brand (2013), who found that scrappage schemes save little CO<sub>2</sub> and may even increase emissions on a life-cycle basis.

This conclusion is in line with Lenski, Keoleian & Bolon (2010) who found that the US scrappage scheme had only a one-off effect of preventing 4.4 million tonnes of CO2 equivalent emissions, which is 0.4% of annual US light-duty vehicle emissions.

On the other hand, scrappage schemes had notable environmental benefits in terms of increased fuel economy, as eligible cars generally had better fuel efficiency (Grigolon et al., 2016). A study on the environmental and safety impacts of scrappage schemes in France, Germany and the United States found that fleet renewal initiatives can reduce CO2 emissions and air pollution and improve road safety. However, the benefits are not sufficient to compensate for the value of the scrapped vehicles (given that these vehicles could still be used reliably for some time). In some cases, net losses have been substantial (Fraga, 2011).

The Spanish experience with the scrappage scheme, written by Jiménez, Perdiguero & García (2016), compared the costs (total amount invested) and benefits (reduction in polluting emissions and additional fiscal revenues) of the scheme in terms of environmental efficiency. It showed that the scrappage scheme would only have a positive outcome if it increased demand by at least 30%. Thus, in the light of the above, the relative incremental environmental benefit of the car scrappage scheme is relatively small compared to the total cost of the fiscal intervention. The potential reduction in CO2 emissions achieved by the schemes could be much higher if the replacement of old vehicles were restricted to hybrid cars in particular (Kagawa et al., 2023). In addition, the benefits may not sufficiently compensate for the value of the vehicles scrapped, resulting in significant net losses in some cases. Therefore, claims of reduced environmental impact and improved road safety should not be the primary justification for implementing scrappage schemes (OECD/ITF, 2011).

**Table 1: Summary of key potential benefits and negatives of car scrappage schemes**

KEY POTENTIAL BENEFITS	KEY POTENTIAL NEGATIVES
<p><b>Stimulating demand:</b> Scrappage schemes can support demand for new cars, which can be particularly valuable during periods of economic uncertainty or recession when the level of consumer spending is lower.</p>	<p><b>High fiscal cost:</b> Scrappage schemes can be expensive to implement, especially if they involve significant subsidies or incentives to consumers.</p>
<p><b>Supporting the automotive industry and its supply chain:</b> By supporting the automotive industry and its supply chain, scrappage schemes can help to protect jobs and maintain employment levels during an economic downturn.</p>	<p><b>Distorting the market:</b> Scrappage schemes can distort the market for new cars by encouraging consumers to buy certain models or brands, which may not be the most efficient or cost-effective options. Scrappage schemes may also favour certain manufacturers over others.</p>
<p><b>Reducing emissions:</b> Scrappage schemes can help remove old, polluting cars from the road, reducing emissions of pollutants that can harm human health and contribute to climate change. Newly purchased cars are also more fuel efficient.</p>	<p><b>Limited environmental benefits:</b> While scrappage schemes can help reduce pollutant emissions, the overall environmental benefits may be limited. There is a need to focus on promoting and stimulating demand, especially for very low emission vehicles (hybrid or electric cars).</p>

<b>Promoting technological innovation:</b> Scrappage schemes can encourage the uptake of newer, cleaner technologies, such as electric and hybrid vehicles, which can support wider environmental objectives and stimulate technological innovation.	<b>Short-term effects:</b> Scrappage schemes may provide a short-term boost to the automotive industry and the economy as a whole, but their effects may not be sustainable in the long run or may be offset by the strategic behaviour of participants.
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Source: Own creation.

## 4. Descriptive analysis of European scrappage schemes

In the European Union, a total of 14 countries introduced some form of scrappage scheme during the economic crisis around 2009: Austria, Cyprus, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Romania, Slovakia, Spain, and the United Kingdom.

Already at the beginning of 2010, European scrappage schemes were described by Buttigieg et al. (2010b). However, their report only covered developments up to the beginning of 2010; it did not cover subsequent developments in the countries that continued the scrappage scheme (France, Luxembourg, Portugal, Romania and Spain), nor could it cover the development of the scrappage scheme in Ireland, which only introduced it in 2010. Their report also often had to rely on preliminary data or did not yet have it available (this often refers to the number of cars scrapped under the scheme).

Since then, no one has described and analysed all European scrappage schemes; only partial studies focusing on selected countries have been produced. This working paper therefore builds on Buttigieg et al. and comes up with a comprehensive description of the scrappage schemes that were implemented in the European Union around the economic crisis. In doing so, it limits itself to the period 2005–2013, which on the one hand provides a sufficiently broad data context for the crisis years, but on the other hand does not lose sight of the economic crisis as the main period and main driver for the introduction of scrappage schemes.

### 4.1 Comparison of scrappage schemes

#### Length of scrappage schemes

Although we have chosen the period 2005–2013 for our research, even this period is not long enough to comprehensively cover all scrappage schemes. It is true that some countries introduced car scrappage schemes as ad hoc, short-term measures primarily intended to stimulate the economy – for example, in Austria the scrappage scheme lasted just over three months, in Slovakia only two months and in Greece only one month (before being abolished by the newly elected government). However, there are also countries where the scrappage scheme continues to this day, albeit in a modified form. Examples are France and Romania.

**Table 2: scrappage schemes in EU countries since 2005**

	<b>Programme name</b>	<b>Period</b>	<b>Duration in months within 2005–2013</b>
<b>Austria</b>	Ökoprämie für Fahrzeugtausch	2009	3.3
<b>Cyprus</b>	Σχέδιο Απόσυρσης και Αντικατάστασης Παλαιών Οχημάτων	2008–2010	17
<b>France</b>	Aide au remplacement des véhicules anciens Aide à l'acquisition ou à la location de véhicules peu polluants	2007–2023 Crisis adjustment of incentives 2008–2010	25
<b>Germany</b>	Pact für Beschäftigung und Stabilität in Deutschland	2009	7.5
<b>Greece</b>	Μέτρα για την ανανέωση του στόλου	2009	1
<b>Ireland</b>	The Scrappage Scheme	2010–2011	18
<b>Italy</b>	Misure urgenti a sostegno dei settori industriali in crisi	1997–2023 Crisis adjustment of incentives 2009	11
<b>Luxembourg</b>	PRIME CAR-e plus	2009–2010	18
<b>Netherlands</b>	Tijdelijke Sloopregeling personen- en bestelauto's	2009–2010	11
<b>Portugal</b>	Programa de Incentivo Fiscal ao Abate de VFV	2000–2023 Crisis adjustment of incentives 2009	5
<b>Romania</b>	Programului de stimulare a înnoirii Parcului național auto	2005–2023	73
<b>Slovakia</b>	Dotácia na kúpu nového osobného motorového vozidla	2009	2
<b>Spain</b>	Plan Renove (1994–1997), Plan Prever (1997–2007), Plan VIVE (2008–2009), Plan2000e (2009–2010), Plan PIVE (2012–2016), Plan Movea (2016–2017), Plan Movalt (2017–2018), Plan Moves (2019–2023)	1994–2023 Analysed period 2005–2013	38
<b>United Kingdom</b>	Scrappage scheme	2009–2010	10.5

Source: Own creation based on national sources. See the sources listed in Annex 1 for each country.

### **Support for scrapping old cars or support for buying new cars**

The table above only includes schemes that included some form of scrapping aid. For the sake of completeness, it should be added that this is not the same as support for the purchase

of new cars. In fact, all possible combinations of mandatory and voluntary scrapping of old cars or purchase of new cars appear in the period considered.

**Table 3: Scrappage schemes and support for new car purchases**

	<b>In order to get the scrapping premium, it was necessary to buy a new car</b>	<b>It was not necessary to buy a new car to get the scrappage premium</b>	<b>There was a separate premium for buying a new car</b>
<b>Austria</b>	Yes	No	No
<b>Cyprus</b>	Yes (2010 only)	Yes (2008–2009)	No
<b>France</b>	Yes	No	Yes
<b>Germany</b>	Yes	No	No
<b>Greece</b>	No	Yes	Yes
<b>Ireland</b>	Yes	No	No
<b>Italy</b>	Yes/No (In the case of not purchasing a new car, the premium was smaller, but the citizen received a public transport ticket allowance)	No	Yes
<b>Luxembourg</b>	Yes	No	Yes (2007–2014)
<b>Netherlands</b>	Yes	No (but Yes in the case of the independent city programmes of The Hague and Amsterdam)	No
<b>Portugal</b>	Yes	No	No
<b>Romania</b>	Yes (but 2010–2012 it was possible to sell the scrapping voucher to another person)	No	No (but 2010–2012 it was possible to buy a scrap voucher from another person and use up to three vouchers in the purchase)
<b>Slovakia</b>	Yes	No	No
<b>Spain</b>	Yes	No	No
<b>United Kingdom</b>	Yes	No	No

*Source: Own creation based on national sources. See the sources listed in Annex 1 for each country.*

A newly purchased car does not always have to be a new car or the first registration of a car. Slovakia allowed a purchased car to be up to six months old and to have travelled up to 6,000 km. Austria and Germany allowed the purchase of cars up to one year old. Spain (until 2010) allowed the purchase of a car up to five years old. Finally, the Netherlands allowed the purchase of a car manufactured in 2001 or later, i.e. more than eight years old. The case of the Netherlands is all the more interesting as the cars to be scrapped had to be older than nine years (diesel engine) or 13 years (petrol engine). This is probably also reflected in the result: a full 70% of the cars purchased were used! (*Evaluatie*, 2010) The impact of the scrappage scheme on the total number of new car registrations was therefore somewhat smaller in the Netherlands and similar countries than elsewhere (although it can be assumed that the increase in used car sales will have a vicarious effect on new car purchases).

### Requirements for scrapped and purchased cars

In terms of eligibility requirements for both car scrapping and new cars, the approaches taken by the different countries varied considerably. This reflected both the cultural specificities of each country (e.g. Italy and Spain had special conditions for multi-person households) and, above all, the objectives of the countries – i.e. whether they were primarily concerned with renewing old fleets, promoting the car industry, making cars cleaner or making roads safer.

The following table summarises each country's priorities.

**Table 4: scrappage scheme priorities**

	<b>Economic stimulus</b>	<b>Environmental protection</b>	<b>Road safety</b>
<b>Austria</b>	Primary		
<b>Cyprus</b>	Secondary	Primary	Primary
<b>France</b>	Primary	Secondary	
<b>Germany</b>	Primary		
<b>Greece</b>	Primary	Primary	
<b>Ireland</b>	Primary	Primary	Primary
<b>Italy</b>	Primary	Primary	
<b>Luxembourg</b>	Secondary	Primary	
<b>Netherlands</b>	Secondary	Primary	
<b>Portugal</b>		Primary	Secondary
<b>Romania</b>	Primary	Primary	

<b>Slovakia</b>	Primary	Secondary	Secondary
<b>Spain</b>	Primary	Secondary	Secondary
<b>United Kingdom</b>	Primary		Secondary

*Source: Buttigieg et al. (2010).*

With regard to scrapped cars, the main criteria considered by the countries were the car category (passenger car or also light commercial vehicle), the required age of the scrapped car and also the required period of ownership of the scrapped car. Countries also differed in terms of whether only natural persons or legal entities could participate in the scheme. Most countries allowed both groups, with the exception of Germany, which limited the pool of eligible candidates to natural persons only. This is also related to the fact that most countries allowed both passenger cars and light commercial vehicles (LCVs) to be scrapped. Although the participation of legal entities was theoretically possible, in practice it could conflict with the age limit of the scrapped vehicle. On average, legal entities renew their fleet more quickly than private individuals. Therefore, a minimum vehicle age of 10 years (which was the most common requirement) could have been more restrictive for companies than for citizens. Some governments seem to have recognised this when they significantly reduced the age limit for LCVs during the economic crisis (Spain) or directly for legal entities (Romania).

The required period of ownership of the scrapped car played a notable role. The introduction of a minimum limit, such as in Slovakia (2 months), effectively prevented the purposive transfer of old cars (although it is debatable whether purposive transfers would be incompatible with the objectives of the scheme). However, the introduction of a limit of 12 months or more was common. In the case of purposive transfers, this was unnecessary as a shorter limit would have been sufficient (e.g. a period since the idea of a scrappage scheme was publicly discussed). As an unintended consequence, it excluded those who had bought an old used car a few months before the scrappage scheme started. Given that poorer citizens are more likely to buy an old used car, this excessively long time limit may have had negative socially discriminatory consequences.

Romania can serve as an illustration of the importance of (not) limiting the period of ownership of a scrapped car. Indeed, in 2010 it introduced the transferability of car scrappage certificates, thus solving a problem faced by consumers in all other countries – the problem of someone wanting to scrap their old car but not wanting to buy a new one, while another person wants to buy a new car but does not have an old one to scrap. In addition, Romania allowed the buyer of a new car to use up to three scrapping certificates, which led to a gap between the number of cars scrapped and the number of new cars bought. While in 2009 the number of cars scrapped and bought was the same at 32,327, a year later the number of cars scrapped increased dramatically to 189,360, while the number of new cars bought rose to 62,550.



**Table 5: Eligibility criteria for scrapped cars**

	<b>Eligible categories of scrapped cars</b>	<b>Required age of scrapped cars</b>	<b>Required length of ownership of the scrapped car</b>
<b>Austria</b>	M1	13 years	12 months
<b>Cyprus</b>	M1	Until April 2008: 20 years As of May 2008: 15 (at least 10 years of which in Cyprus)	N/A
<b>France</b>	M1, N1	Until November 2008: 15 years December 2008 – 2010: 10 years Since 2011: 15 years	6 months
<b>Germany</b>	M1	9 years	12 months
<b>Greece</b>	M1, N1	Euro 3 (which implicitly meant less than 5 years)	N/A
<b>Ireland</b>	M1	10 years	18 months
<b>Italy</b>	M1, N1	2007: Euro 1 (which implicitly meant 13 years) Since 2008: 11 years and Euro 2 at most 2009: 9 years and Euro 2	N/A
<b>Luxembourg</b>	M1	10 years	12 months
<b>Netherlands</b>	M1, N1	9 years (diesel) 13 years (petrol) (+higher incentive for older cars)	15 months
<b>Portugal</b>	M1, N1	Until 2009: 10 years 2009–2010: 8 years Since 2010: 10 years	12 months
<b>Romania</b>	M1, N1 (since June 2009)	Until 2009: 12 years Since 2009: 10 years 2012: 5 years (legal entities)	N/A
<b>Slovakia</b>	M1	10 years	2 months
<b>Spain</b>	M1, N1 (except 2007)	Until 2007: 10 years 2008 until October: 15 years November 2008 – May 2009: 10 years or at least 250,000 km May 2009 – 2010: 10 years or at least 250,000 km (if purchased new) May 2009 – 2010: 12 years old and purchased as no more than five years old (if purchased used) 2012 – February 2013: 10 years passenger car, 12 years LCV March 2013 – December 2013: 10 years passenger car, 7 years LCV	N/A

<b>United Kingdom</b>	M1, N1	10 years	12 months
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Source: Own creation based on national sources. See the sources listed in Annex 1 for each country.

In terms of car purchases, in most countries a new car was required and only in some cases was it possible to buy a used car (as mentioned above). This also had a direct impact on the emission levels of a new car – all new passenger cars had to comply with Euro 4 since 2005 and Euro 5 since October 2009, whether or not this was required under the terms of the scrappage schemes.

In addition, about half of the countries have decided to require compliance with CO<sub>2</sub> emission limits and have therefore designed the scrappage scheme as a measure against global warming. Whether intended or not, this had an impact on the size of cars bought under the scheme. It is easier to meet the CO<sub>2</sub> emission limit with a smaller engine and a smaller car. Some governments then directly encouraged the purchase of cheaper cars – for example, Slovakia only allowed the purchase of a car costing up to €25,000 and Spain (from 2012) had a price cap of €30,000.

However, it can be assumed that even without emission limits and price caps, the scrappage scheme led to a preference for cheaper cars. One reason for this is that car scrappage premiums were given in absolute terms, i.e. their relative importance decreased the more expensive the car was. The second reason is the different elasticity of demand for different groups of consumers. Those who are able and willing to buy a luxury car are likely to have a lower price elasticity than those who prefer mid- and low-priced cars. Participation in the scrappage scheme may therefore be less attractive to them.

**Table 6: Eligibility criteria for purchased cars**

	<b>Age of the purchased car</b>	<b>Required Euro standard</b>	<b>Other environmental requirements</b>
<b>Austria</b>	New or one year old	Euro 4	
<b>Cyprus</b>	New	Implicitly Euro 4	2008–2009: consumption up to 7 l/km 2010: emissions 160 g CO <sub>2</sub>
<b>France</b>	New	Implicitly Euro 4	Emissions 160 g CO <sub>2</sub>
<b>Germany</b>	New or one year old	Euro 4	
<b>Greece</b>	New	Euro 4	
<b>Ireland</b>	New	Implicitly Euro 4	Emissions 140 g CO <sub>2</sub>

<b>Italy</b>	New	Euro 4	Emissions 140 g CO <sub>2</sub> (petrol) Emissions 130 g CO <sub>2</sub> (diesel)
<b>Luxembourg</b>	New	Implicitly Euro 4	Emissions 150 g CO <sub>2</sub> Emissions 160 g CO <sub>2</sub> (cars for large families)
<b>Netherlands</b>	New and used (first registration 2001 and later)	Euro 4 or particulate emissions up to 5 mg per km	Diesel with diesel particulate filter
<b>Portugal</b>	New	Implicitly Euro 4	2009: 140 g CO <sub>2</sub> emissions 2010: 130 g CO <sub>2</sub> emissions
<b>Romania</b>	New	Implicitly Euro 4 Since 2010: implicitly Euro 5	
<b>Slovakia</b>	New and used (up to 6 months and 6000 km)	Implicitly Euro 4	
<b>Spain</b>	New Up to 2010 and used (up to 5 years old)		From 2008: 120 g CO <sub>2</sub> emissions or 140 g plus electronic stability control and occupant sensors in the front seats From 2009: 120 g CO <sub>2</sub> emissions, or 149 g CO <sub>2</sub> plus electronic stability control and front seat occupant sensors, or 149 g CO <sub>2</sub> three-way catalytic converter for petrol vehicles or an exhaust gas recirculation (EGR) device for diesel vehicles, or 160 g CO <sub>2</sub> for LCVs Since 2012: At least 15% lower fuel consumption than the Spanish average From 2013: family cars at least 5% more fuel efficient than the Spanish average
<b>United Kingdom</b>	New	Implicitly Euro 4	

Source: Own creation based on national sources. See the sources listed in Annex 1 for each country.

## Financial incentives for scrappage schemes

Just as countries differed in their eligibility criteria, they also differed in the setting of financial incentives. Only three countries (Austria, Germany and the United Kingdom) had a single level of scrapping premium. All other countries graded the amount of the premium according to different criteria – often emission values or engine type. In Slovakia (in the first wave), the level of the scrappage premium depended on whether the dealer also provided a discount.

Similarly, it was typical to adjust the level of the scrapping premium when the scheme was extended – only Germany and the UK did not change the level of incentives when extending

the scheme. (Greece and the Netherlands were the only countries that did not extend the scheme; Greece even shortened it when the new government abolished it after the general election.)

Greece can serve as an example of a country that introduced other measures that have proved to be even stronger than the scrapping. In 2009, it halved registration fees for four months. Given that these fees were very high in Greece (compared to neighbouring countries), this had a significant effect on the car market. (For this reason, we include this scheme in the statistical analysis below, although it is not a scrappage scheme.)

Another example is Portugal, which has had a scrappage scheme since 2000. In 2007, although it did not change the set-up of the scrappage scheme, it reduced the bureaucratic requirements and, above all, changed the set-up of the road tax – whereas before it was a charge on the operation of the vehicle, since 2007 it has been changed to a charge on the possession of the vehicle. Thus, old cars not in use suddenly had a negative value for their owners, which significantly motivated their scrapping.

**Table 7: Financial settings for scrappage schemes**

	<b>Amount of financial incentive</b>	<b>Actual average scrapping premium per scrapped car</b>	<b>Required vendor contribution (discount)</b>	<b>Average scrapping premium per scrapped car as a share of GDP per capita</b>
<b>Austria</b>	€750	€750	€750	2.17%
<b>Cyprus</b>	€256–1800	€885	---	3.75%
<b>France</b>	€300–1000	€861	---	2.84%
<b>Germany</b>	€2500	€2500	---	8.37%
<b>Greece</b>	€500–2200	€1400	---	6.55%
<b>Ireland</b>	€1250–1500	€1412	---	3.85%
<b>Italy</b>	€1500–3000	€1212	---	4.54%
<b>Luxembourg</b>	€1500–3250	€2171	---	2.71%
<b>Netherlands</b>	€750–1750	€987	---	2.59%
<b>Portugal</b>	€1250–1500	€1416	---	8.53%
<b>Romania</b>	€850–1460	€811	---	3.26%

<b>Slovakia</b>	€1000–1500	€1127	Wave 1: Voluntary €500 to increase the state premium Wave 2: €1000	9.47%
<b>Spain</b>	€480–2080	€1085	From 2009: €1000–1500 (depending on the amount of the scrapping premium)	4.61%
<b>United Kingdom</b>	€1110	€1110	€1110	4.42%

*Source: Own creation based on national sources and World Bank data. See the sources listed in Annex 1 for each country.*

## **4.2 Comparison of the economic performance of scrapping schemes**

As shown above, the scrapping schemes were very diverse in almost all aspects of their set up and duration. Nevertheless, it is possible to compare at least what they all had in common, namely the scrapping of old cars and the corresponding costs for public budgets. To our knowledge, no one has yet made such a comparison. The likely reason is that information on the final uptake of the scrapping scheme and the final number of vehicles supported is not a common part of statistical outputs.

We have spent considerable time searching for the data. In some cases, the competent public authority has produced a final report or at least included the information in its annual report (e.g. Cyprus or France). In other cases, the information was provided by the relevant authority (e.g. Germany, Romania), but this was a different institution in each country. Often it was only necessary to look for information in the media because official information is not available at all. This is also related to the length of time that has elapsed since the end of the scrapping schemes. A lot of information has been removed from the internet and cannot be found even in internet archives. Enquiries to the relevant national institutions are not always successful (for example, the Slovak Association of the Automotive Industry refuses to search for old documents in its archives).

In all cases, the relevant information is only available in the national language, which makes searching significantly more difficult. In one case, Greece, unfortunately the final figures could not be obtained in any way. In this case, we rely on the rough estimate of Buttigieg et al. (2010a) and note that its predictive value is very low.

**Table 8: Scrappage scheme budgets and scrappage numbers**

	<b>Sources of information</b>	<b>Budget drawn</b>	<b>Budget drawn as a share of GDP</b>	<b>Total cars scrapped</b>	<b>Total cars scrapped as a share of the total fleet in 2009</b>
<b>Austria</b>	News in the media	€22.5 million	0.008%	30,000	0.63%
<b>Cyprus</b>	Ministry annual reports	€21.9 million	0.116%	24,755	4.20%
<b>France</b>	Ministry annual reports Annual reports of the relevant Commission	€1015 million (2009–2010)	0.052%	1,179,417	3.15%
<b>Germany</b>	Final report of the Authority	€4,832 million	0.197%	1,932,929	4.33%
<b>Greece</b>	Estimate by Buttigieg et al. (2010a)	€108 million	0.045%	77,000	1.24%
<b>Ireland</b>	News in the media	€37.6 million	0.022%	26,632	1.19%
<b>Italy</b>	Car club report Buttigieg et al. (2010a)	€1,284 million (2009)	0.081%	1,059,504	2.57%
<b>Luxembourg</b>	Chamber of Commerce report	€15.2 million.	0.038%	7,000	1.90%
<b>Netherlands</b>	Analytical Agency Report	€82.4 million.	0.013%	83,444	0.94%
<b>Portugal</b>	Annual reports of the relevant authority	€59.1 million (2009)	0.034%	41,735	0.72%
<b>Romania</b>	Annual reports of the relevant authority	€390.4 million (2005–2013)	0.307%	481,543	9.73%
<b>Slovakia</b>	Ministry reports	€49.8 million	0.078%	44,200	2.34%
<b>Spain</b>	Royal Decrees News in the media Presentation of the relevant institute	€972.4 million (2008–2014)	0.092%	896,519	3.27%
<b>United Kingdom</b>	Scheme website	€436 million	0.028%	392,227	1.15%

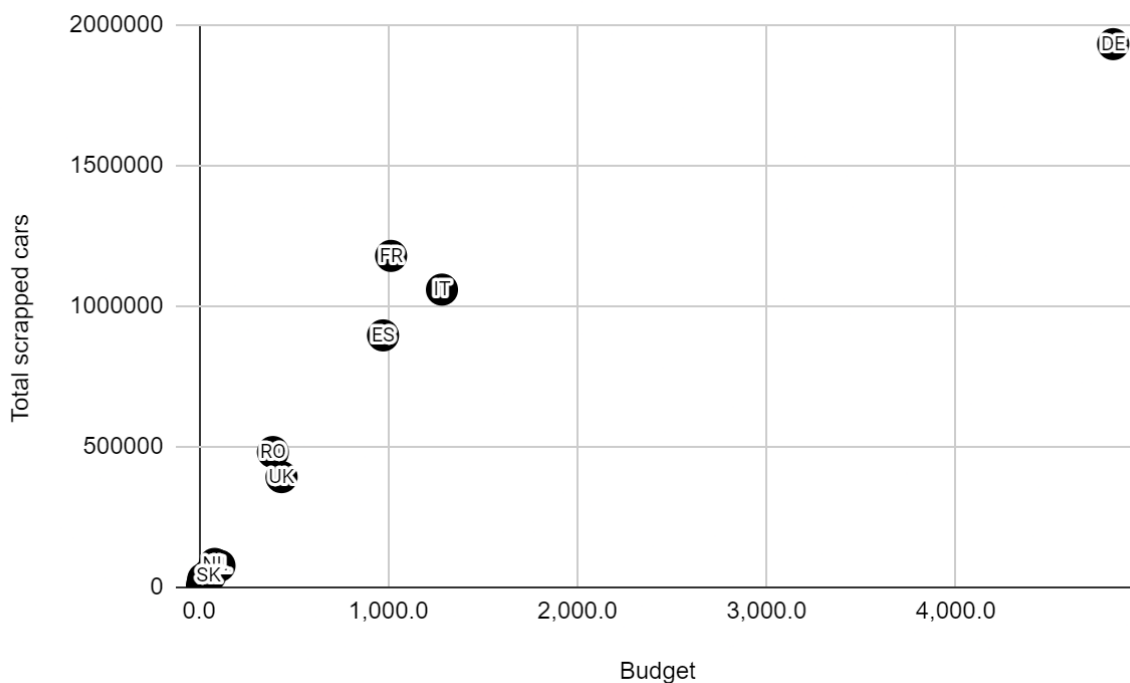
Source: Own creation based on national sources, World Bank data, European Motor (2012), and CEIC (2023). See the sources listed in Annex 1 for each country.

The size of the data is not such as to justify a correlation analysis. We will therefore limit ourselves to a visual representation of selected aspects and their interpretation.

### Effect of budget level

First of all, the number of scrapped cars can be expected to be related to the size of the budget. This is illustrated in the following graph.

**Figure 5: Comparison of the total number of scrapped cars and the total budget of the scheme**

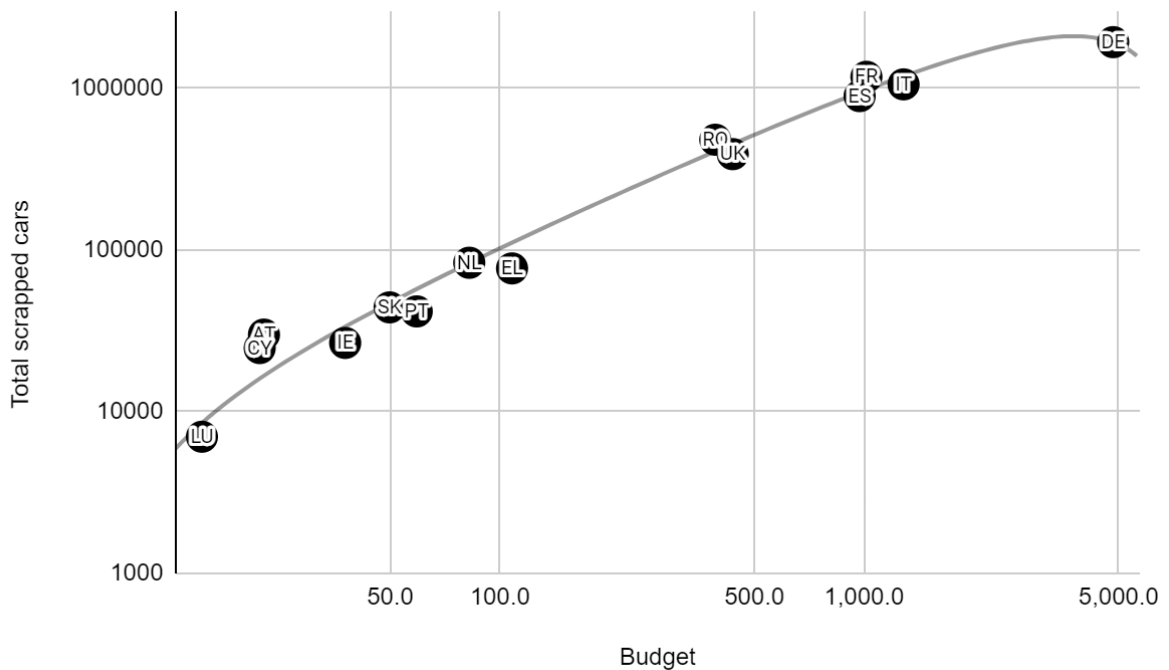


Source: Own creation.

Attention is immediately drawn to the remote observation that Germany represents. It spent four times (!) more on the scrapping scheme than Italy, the country with the second largest scheme. Yet the German scheme lasted a third less time. Another comparison: Germany spent more on the scrapping scheme than all other countries combined.

Given the large variance of budgets, it is appropriate to use a logarithmic transformation of the two axes to make the relationship between the two variables more visible. The result is shown in the following graph.

**Figure 6: comparison of the total number of scrapped cars and the total budget of the scheme**



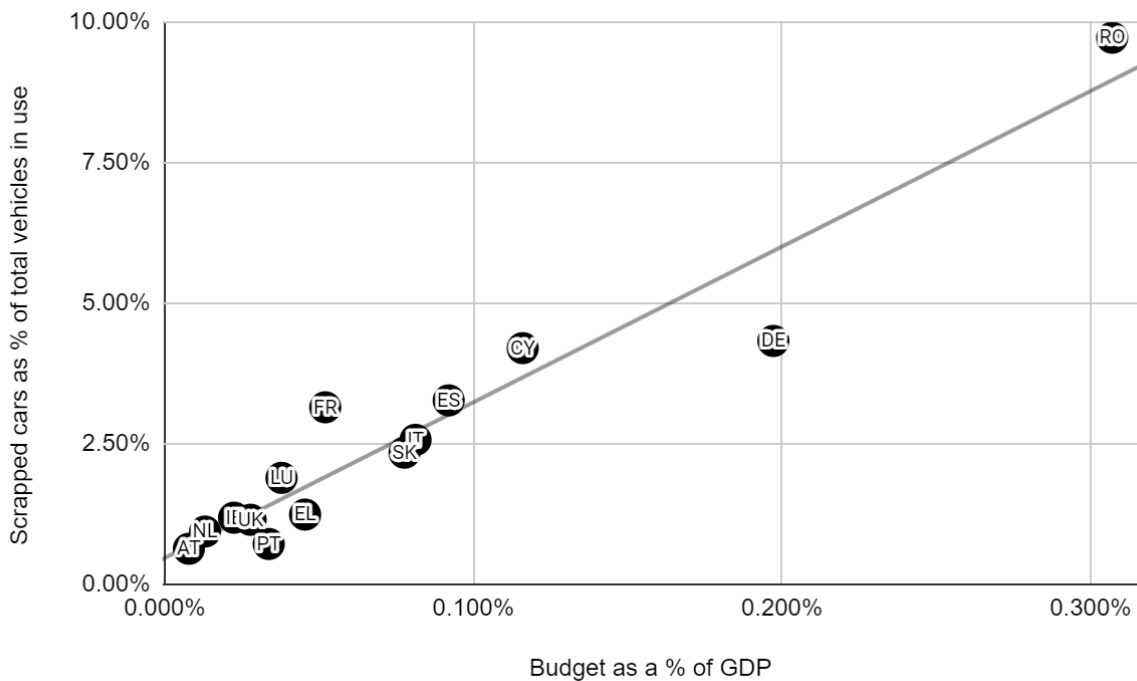
*Source: Own creation.*

Unsurprisingly, there seems to be a correlation between the amount of funds spent and the number of cars scrapped under the scrapping scheme. The distribution of countries in the graph is probably best described by a polynomial trend. This suggests that less budget-intensive schemes tend to be more efficient.

The size of the budget of a scrapping scheme, however, may be related to the size of the market. It is therefore useful to put the budget of the scheme in the context of the GDP of the country, and similarly the number of scrapped cars in the context of the total fleet of the country. A comparison between countries can be seen in the following chart.



**Figure 7: Comparison of the share of end-of-life vehicles in the total fleet and the share of the scheme budget in GDP**



Source: Own creation.

The outlying position on the top right of this chart no longer belongs to Germany. It is Romania, which ran a scrappage scheme throughout the whole period 2005–2013 and no sub-periods significantly related to the crisis years. (This is different from France, Italy, Portugal and Spain, which had a longer scrappage scheme, but we only include the period related to the economic crisis in our analysis.)

This chart can serve as a rough comparison of the effectiveness of the scrappage scheme. For example, Germany’s fleet renewal rate was only slightly higher than Cyprus (4.33% compared to 4.19%), but the budget spent as a proportion of GDP was 1.7 higher. Spain and France are a similar case: the fleet renewal rate in Spain is higher by 4%, but the budget spent as a share of GDP is higher by 77%.

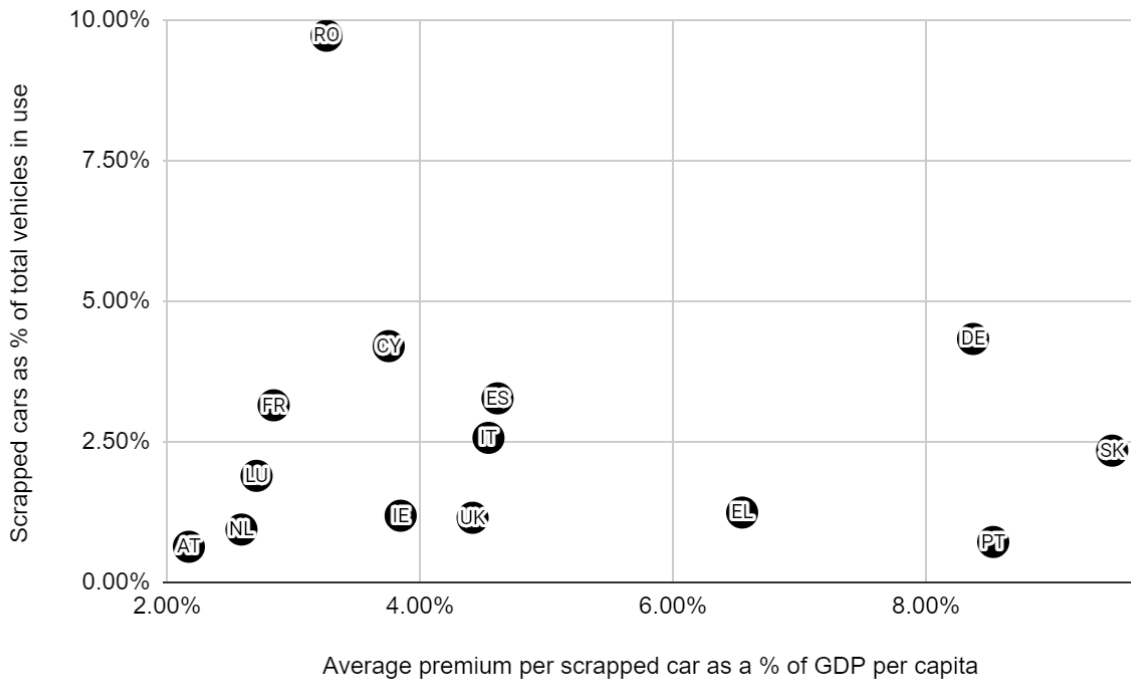
The trend line shown will also help interpretation. Simply put, countries above the trend line have been able to renew their fleets at a lower than average cost.

### Effect of the amount of the scrapping premium

Next, we ask whether the total number of scrapped cars is related not only to the total budget but also to the amount of the scrapping premium. (For the actual average amount of the scrapping premium, see the table above on Financial settings for scrappage schemes.) However, no clear relationship emerges from the data. Nor does it emerge when the level of the scrapping premium is recalculated in terms of GDP per capita, to take into account that

the same absolute level of premium may present different incentives in different rich countries. On the contrary, the link tends to disappear, see the following graph.

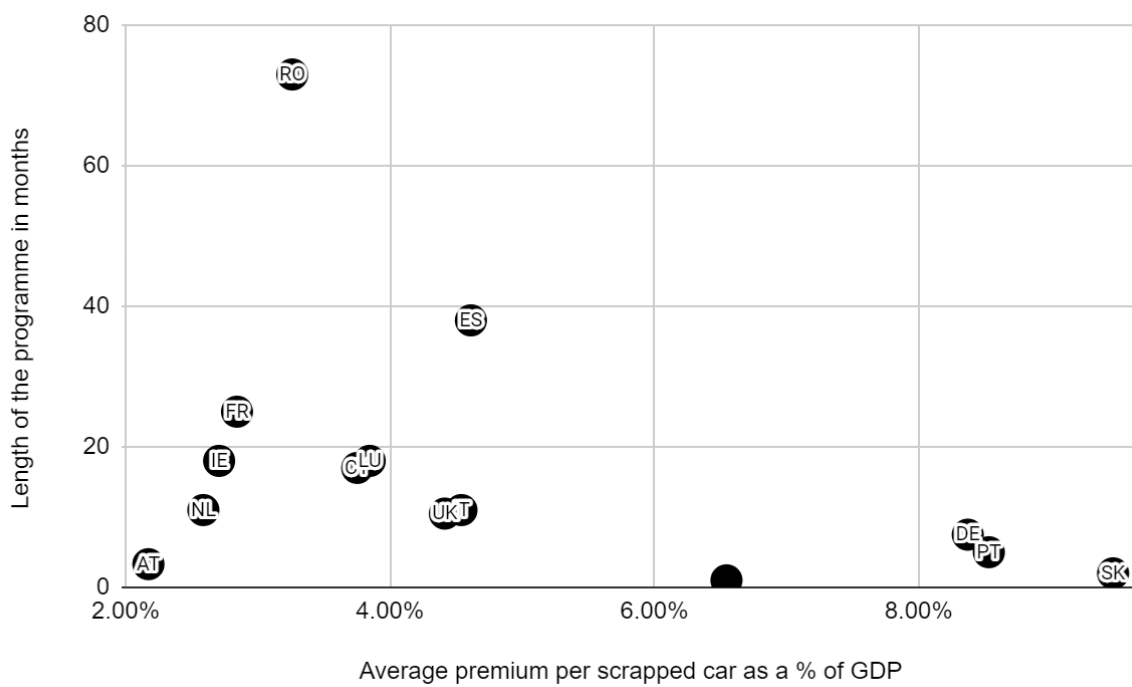
**Figure 8: Comparison of the share of scrapped vehicles in the total fleet and the share of the average scrapping premium in GDP per capita**



Source: Own creation.

The outlying observation in this graph (top left point) belongs to Romania. But this is not evidence of the extraordinary effectiveness of the Romanian scrapping scheme. Rather, it is that the Romanian scheme has lasted considerably longer than those in other countries and has naturally scrapped more cars. Theoretically, it can not be ruled out that the length of the scrapping scheme and the level of the scrapping premium are interdependent. However, the data do not support this hypothesis, either in absolute terms or relative to GDP per capita. See the following chart.

**Figure 9: Comparison of the length of the scrappage scheme and the share of the average scrapping premium in GDP per capita**

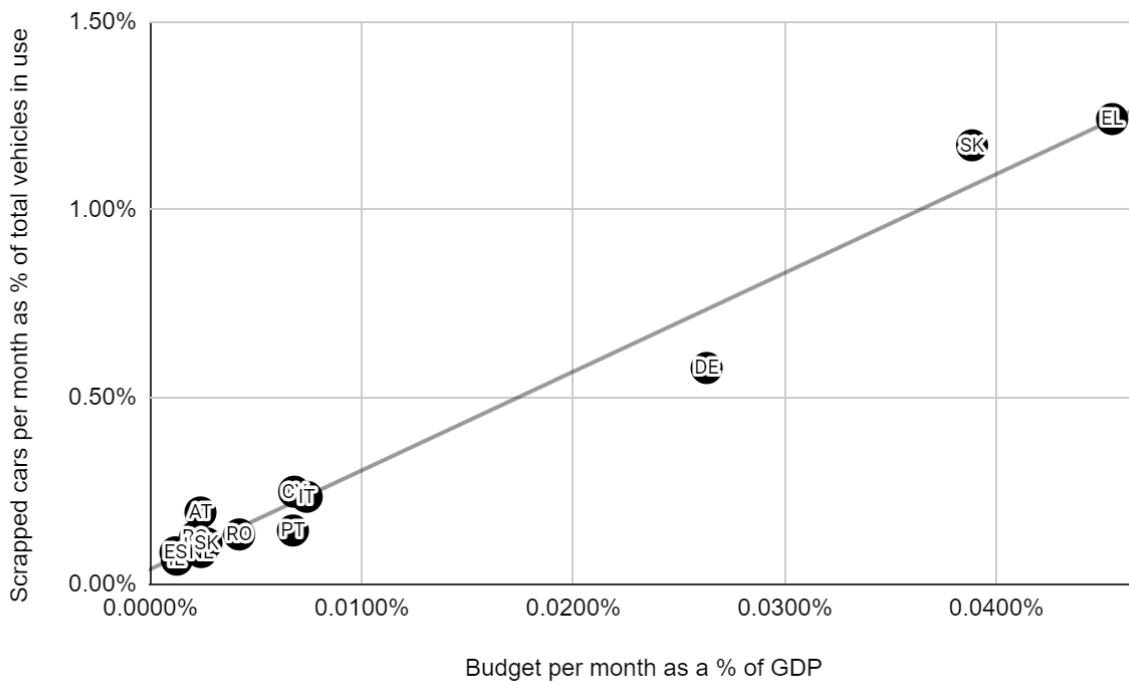


Source: Own creation.

### Comparison of monthly averages

It is therefore necessary to transform the data to adjust for the length of the scrappage scheme. We have chosen to convert to one month.

**Figure 10: Comparison of the monthly share of scrapped vehicles in the total fleet and the monthly share of the scheme budget in GDP**

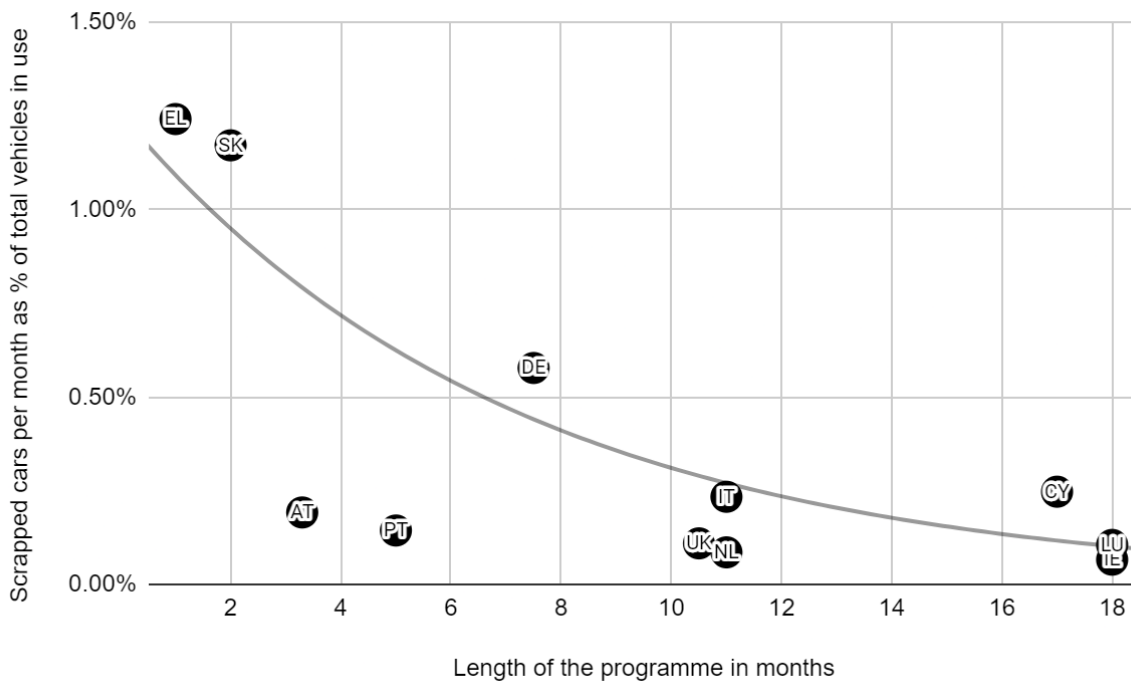


Source: Own creation.

This graph shows a linear relationship between the monthly number of scrapped vehicles and the monthly budget utilisation of the scrappage scheme. This is quite natural, as the number of scrapped cars must logically be reflected in the scheme’s spending. It is rather the vertical distribution of the countries that is more telling in terms of the rate at which cars were scrapped during the scheme. In the vast majority of countries, up to 0.25% of the fleet was replaced per month. However, there are three countries where the rate was significantly different, indicating that there was indeed a high level of interest in the scheme from premium recipients. In Germany, an average of 0.58% of the fleet was renewed each month of the scheme. In Slovakia, it was even 1.17%. Greece is the clear winner with a 1.24% renewal rate – though in the case of Greece it should be noted that these are only estimates.

Some explanation can be found in the fact that all three countries operated the scrappage scheme for a limited period of time – Germany for 7.5 months, Slovakia for 2 months and Greece for just one month. Thus, those interested in the scrappage scheme may have feared that the funds would quickly run out. However, this idea cannot be generalised, as the following chart shows.

**Figure 11: Comparison of the monthly percentage of scrapped vehicles in the total fleet and the length of the scrappage scheme**

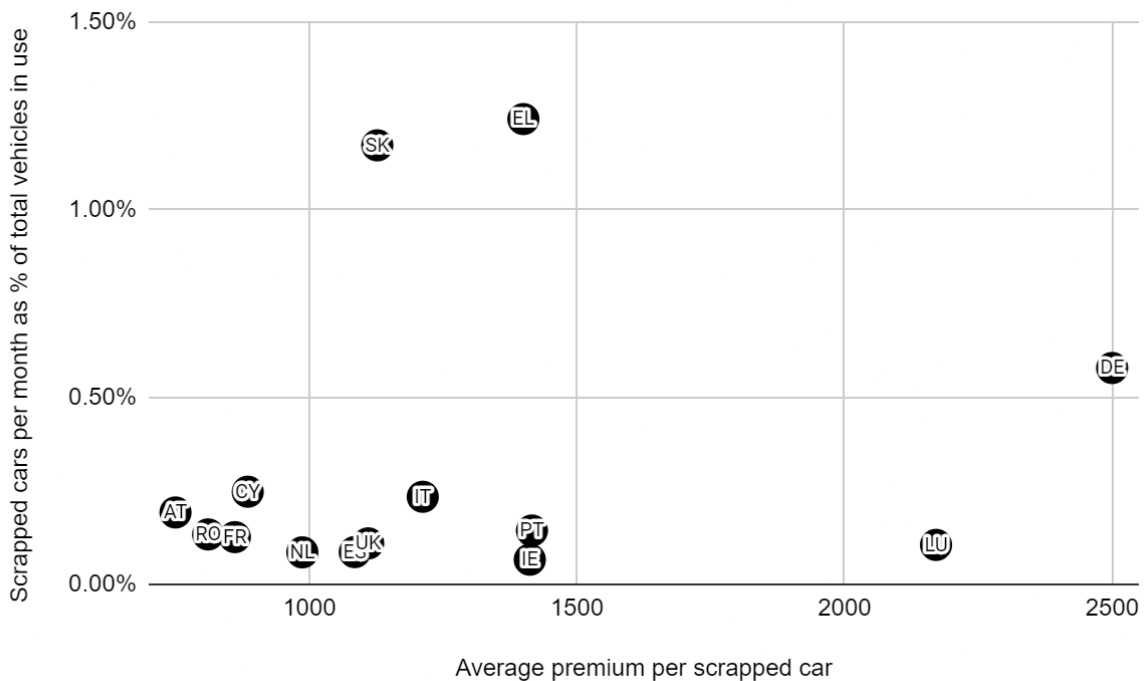


Source: Own creation.

A negative relationship between the length of the scheme and the scrapping rate of old cars can be traced in the graph. At the same time, however, we can also see one country with a very short scheme, Austria, where the scheme lasted just over 3 months but did not attract above average interest. The monthly scrapping rate of old cars in Austria was lower than in Italy, where the scheme lasted more than three times longer. (A similar conclusion could be drawn for Portugal, which achieved a scrappage rate only marginally higher than the UK, although the length of the scheme was half that of the UK. In the case of Portugal, however, this was only a temporary intensification of a scheme that had otherwise worked before and after. So people may not have been so worried about a definitive end to the scrappage scheme.)

It can be expected that the interest in the scheme will be determined primarily by the amount of the scrapping premium rather than the length of the scheme. The length of the scheme was not always known in advance – when the budget was exhausted, some governments extended the scheme, while others did not; and because extensions were the result of political negotiations, consumers could not effectively anticipate them in advance.

**Figure 12: Comparison of monthly scrapped vehicles as a proportion of the total fleet and the average scrapping premium**



Source: Own creation.

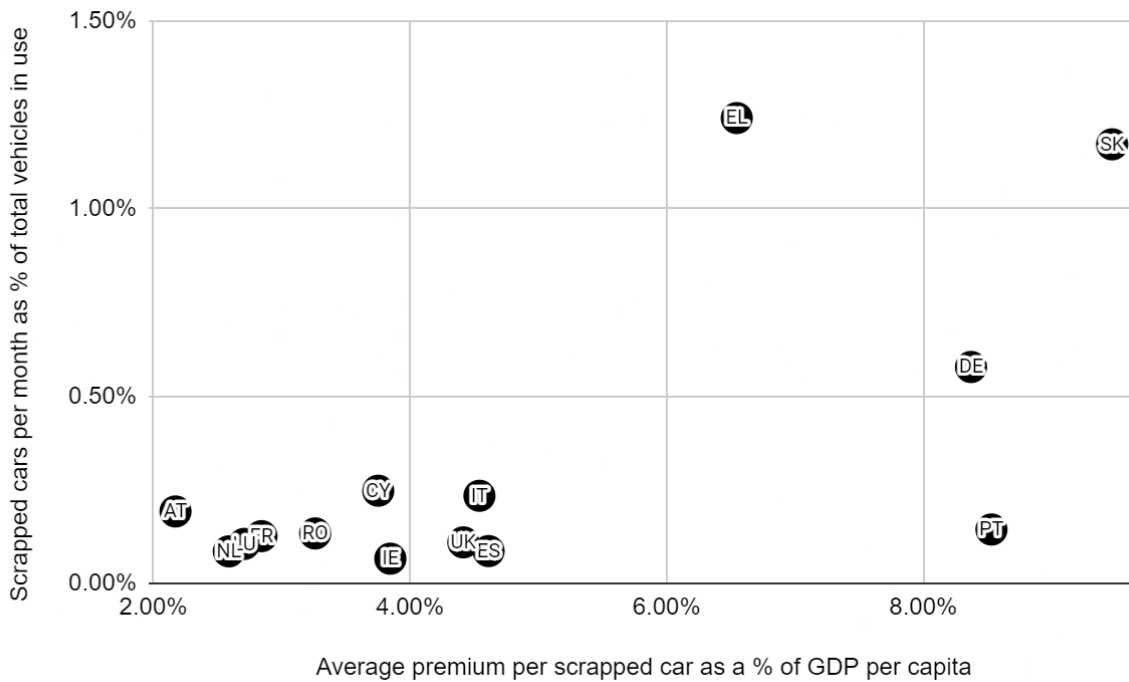
Similar to the comparison of the monthly share of scrapped vehicles in the total fleet and the monthly share of the scheme budget in GDP, there are several outlying observations, in addition to the fact that most countries cluster together. In this case, however, the grouped countries show no clear relationship – the rate of scrapping of old cars does not seem to be related to the size of the premium. This can be clearly seen by reading the graph horizontally on countries such as Luxembourg, the UK, France and Romania. All three had roughly the same fleet renewal rate, but while Luxembourg had an average scrapping premium of €2,171, in the UK it was €1,110, in France €861, and in Romania even just €811.

A vertical reading of the chart is similarly informative: Ireland, Portugal and Greece had similar scrapping premiums of around €1,400. Compared to Ireland, Portugal’s fleet renewal rate was double, and Greece’s rate even 18 times higher.

The countries that lie outside the main group are (from left to right) Slovakia, Greece, Luxembourg and Germany. Leaving aside Greece, where rough estimates are concerned, Slovakia was the best performer. At about the same premium as the UK, it achieved a fleet turnover rate almost 11 times higher. With the exception of Germany, Slovakia’s rate was at least four times higher than all other countries. Luxembourg is the opposite case: the fleet replacement rate was similar to Austria, but the average scrapping premium was almost three times higher.

It is of course possible that the same level of scrapping premium works differently in countries with different levels of living standards. The aforementioned Luxembourg had a GDP per capita 2.3 times higher than Austria in 2009. It is therefore worth using the conversion of the scrapping premium to GDP per capita to capture the effect of the wealth of a society.

**Figure 13: Comparison of monthly scrapped vehicles as a share of the total fleet and the average scrapping premium as a share of GDP per capita**



Source: Own creation.

From this perspective, the Luxembourg scrapping premium suddenly looks relatively low. In contrast, the Portuguese premium is relatively high in the context of local GDP per capita, as is the scrapping premium in Slovakia. In Slovakia, at least, there has been relatively rapid fleet replacement, whereas in Portugal there has not. Germany remains one of the outliers in this graph – it looks that even taking into account the relatively high standard of living in Germany, the level of the scrapping premium is above average.

### Summary of the comparison

The aim of this section was to compare different scrapping schemes in terms of their ability to achieve intensive scrapping of old cars. It turns out that, although there is a (unsurprising) relationship between the amount of budget used and the number of cars scrapped, no such relationship can be clearly established for the relationship between the level of the scrapping premium and the number of cars scrapped. Even if we take into account the size of the countries and the length of each scheme, and thus measure scrapped cars as an average monthly share of the total fleet, no relationship emerges. Similarly, no correlation starts to

show up when we control for country wealth and measure the scrappage premium as a share of GDP per capita. The only relationship that can be identified is a negative relationship between the length of the scheme and the scrapping rate of old cars – shorter schemes scrap cars faster.

While it is not possible to trace significant dependencies that apply to all countries, it is possible to identify countries that perform significantly differently from others. The first such country is Greece, but the data are not entirely reliable. However, if it were true, it would mean that Greece was scrapping cars the fastest of all countries (i.e. the attractiveness of the scheme was huge). This should be explained by the fact that the scheme was introduced at the time of the general election. The incoming government announced in advance that it would abolish the scheme and indeed did so after only one month of operation. The scrappage scheme could thus be seen as an opportunity that could be cancelled any day and that would not be repeated. On the other hand, if we look at the relationship between the size of the budget as a share of GDP and the total number of scrapped vehicles as a share of the Greek fleet, Greece is performing rather below average – that is to say, the scrapping plans have been rather costly to implement.

The second country worth mentioning is Slovakia, where the scrappage scheme operated for the second shortest period of time, two months. In terms of what percentage of the vehicle fleet the country has replaced and what percentage of GDP it has spent, Slovakia has performed on average. However, it was surprising how much it managed to achieve in such a short time. By comparison, Italy's scheme replaced only a slightly larger percentage of its fleet (2.57% compared to 2.34%), but its scheme took 5.5 times longer.

Germany not only had the highest average scrapping premium, but also spent more on its scrappage scheme than all other countries combined. A comparative analysis shows that the setting of conditions in Germany was more generous than necessary. In terms of what percentage of the fleet the country replaced and what percentage of GDP it spent in doing so, Germany performed below average. A comparison with Cyprus is helpful: both countries renewed about the same percentage of the fleet (Germany 4.33%, Cyprus 4.20%), but the German premium was almost three times higher. (If one takes the premium relative to GDP per capita, the German premium was more than twice as high.)

Finally, let's mention Austria and Portugal together. Austria has managed to achieve a slightly higher fleet turnover than Portugal. At the same time, its budget was two and a half times lower and the duration of the scheme was a third shorter. It would seem that it is not so much Austria's success (which is not clearly outperforming other countries) as Portugal's failure. We attribute this to the factor already mentioned above: while in the case of Austria the scrappage scheme was a time-limited innovation, in Portugal it was merely a parametric adjustment of an existing scrappage scheme, which, moreover, continued to operate after the crisis years.



## 5. Quantitative analysis

### 5.1 Research objectives

Methodology for this research is rooted in its distinctive value and broad scope. By conducting a comprehensive analysis across all EU countries that implemented car scrappage schemes, this study is extending previous research, which primarily focused on individual or select countries. The following aspects are considered to be the main contributions of this research:

- Authors specifically delved into the periods these policies were enacted and their variations. At the same time, authors distinguish between the anticipation, treatment and pull-forward periods in deep detail for each country.
- Furthermore, authors innovatively combined the synthetic control method and the difference-in-differences method, providing robust analytical frameworks that enhance the accuracy of attained findings.
- Methodology includes a detailed investigation of Slovakia's car scrappage scheme, facilitated by access to comprehensive data previously not yet used for academic research.

In the context of the above mentioned, following research questions were formulated:

#### **Q1: Did scrappage schemes affect the number of new registrations in individual European countries?**

We assume that there have been certain changes in the number of registered vehicles as a result of the introduction of the scrappage scheme. To identify the size of this effect in each country, we simulate the synthetic control variable (including a specific combination of countries where scrappage schemes have not been implemented) and compare the development of the number of passenger car registrations through difference-in-differences method (these methods are explained in more detail in the following section).

In addition, we extend previous research by carefully identifying periods when subsidy support was active (specific years and months) and also identify periods prior to implementation when, for example, governments sent out messages to society that scrappage would be introduced. Even these announcements may have influenced the evolution of demand for new vehicles. Similarly, we expect that during the post-scrappage period demand may have changed.

#### **Q2: Did the car scrappage scheme in Slovakia affect different brands in different ways with regard to new passenger car registrations?**

Similarly, in Slovakia, a certain fluctuation in the number of new passenger car registrations can be expected as a result of the introduction of the scrappage scheme. In addition to the above mentioned Q1, we also focus on the comparison of Slovakia and the Czech Republic (where the scrappage scheme was not implemented), since these countries are culturally and

economically very similar (especially with regard to the common history and high importance of the automotive industry for the national economy), by means of the difference-in-differences method. More detailed data allows us to compare not only the total number of new car registrations, but also the number of registrations with respect to the brand<sup>4</sup> of the vehicle.

### **Q3: Did the scrappage scheme in Slovakia affect the number of sales of locally produced cars?**

In this case, we assume that people could naturally purchase not only domestically produced passenger cars but also imported ones. This purchasing behaviour could ultimately undermine the stated objective of supporting domestic car production. Using detailed data (new registrations by brand of the vehicle) and difference-in-differences method, we can again compare which brands of passenger cars were most often newly registered in Slovakia and the Czech Republic, and therefore determine whether domestic production was really supported, or rather the sale of cars produced abroad.

### **Q4: Did the scrappage scheme in Slovakia affect the number of deregistered cars?**

To complement and verify the results including the number of new passenger car registrations, we also complement the analysis by comparing the development of the number of car deregistrations in Slovakia during the period when scrappage scheme was active. In doing so, we use monthly data on the overall number of deregistered vehicles in Slovakia and the Czech Republic, again using the difference-in-differences method. We further look at the weighted average of age of the deregistered cars, to see what the scrappage scheme changed the type of cars being deregistered.

## **5.2 Data overview**

### **European countries**

First of all, we approached individual national statistical offices and other relevant institutions, ministries, national and international industry associations that collect data on the number of cars produced, the number of newly registered cars or data on de-registrations in individual European countries. However, the requirement for the provision of such data in the period 2006–2012 in a monthly breakdown as well as a breakdown by individual brands and types of vehicles proved to be impossible for many institutions. The most common reason for this is, for example, that these data are only reported on an annual / quarterly basis or that some of them are not available at all. Some institutions were then willing to provide these data only on the condition of financial compensation (e.g. the Hungarian Central Statistical Office offered to provide these data for a fee amounting to €1,360 + VAT, see Annex 2). Thus, more detailed datasets on the number of newly registered cars were only obtained for Germany, Austria, Sweden, Denmark, Estonia, Finland, Lithuania, the Czech Republic and

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<sup>4</sup> In this analysis, we work with individual car brands, even if they were part of the same car make (manufacturer).

Slovakia. However, only Germany and Slovakia represent countries that have implemented the scrappage scheme in the past.

Therefore, as the most suitable dataset for the analysis of the scrappage scheme in a whole European context were chosen the data on the number of newly registered cars on a monthly basis provided by the European Automobile Manufacturers' Association (ACEA). While these data do not offer a more detailed insight into the brands and types of vehicles, they do, on the other hand, offer the possibility of comparing the development of new car registrations in all European countries. Moreover, this time series is available for the period of 1990–2021.

### **Czechia and Slovakia**

Particular attention was paid to data collection from Slovakia and the Czech Republic, where the aim was to carry out further analyses beyond what was possible for all European countries. In particular, the analysis of scrapped cars and a more detailed analysis of new registrations by brand, model, fuel type, etc. We approached the relevant automotive industry associations with a request for data, where we were unfortunately unsuccessful. The approach of the Slovakian association was particularly strange, as it first promised to provide the data, but changed its mind after finding out the extent of the data and refused to search its archives. (Although these were files that had been freely available on its website in the past.) Unfortunately, not all the relevant files were found in the Internet Archive Wayback Machine.

Instead, it was possible to retrieve two large data files of the Slovak Road Vehicle Register from the Slovak Ministry of the Interior, data from 2005 onwards. The first file contained data on all scrapped vehicles individually and was used in our research. The second file contained complete data on first registrations of road vehicles, individually for all vehicles for the last 17 years. Unfortunately, this data could not be used in the end. This is because the Road Vehicle Register does not keep a history of changes for individual vehicles, i.e. it only lists the most recent change in status for each vehicle (whether it is, for example, a registration, a change of registration plate, a change of owner or a scrappage). However, the date of the first registration in the Slovak Republic is kept for each vehicle, so statistical processing should be possible. Nevertheless, despite repeated attempts, it has not been possible to obtain results from the dataset that would be compatible with the aggregated official statistics. Even the cooperation of the Slovak Ministry of the Interior did not help, and after a few months it was therefore necessary to abandon this part of the research (i.e. detailed research by car brand and model, fuel type, etc.). Instead, we used data on new registrations broken down by car brand, which we managed to find in the internet archives. We also contacted former students who wrote their theses on Slovakia and collected some data from them. In this way we managed to compile at least data for the years 2008–2010.

In the Czech Republic, we also asked for data from the Central Register of Road Vehicles. Here, in addition to the problem with the lack of memory of the register (described above), there was also a problem with the availability of archive data. The data were processed by the Ministry of the Interior until 2013, which then handed over the agenda to the Ministry of Transport, which still manages the register today. Each of these institutions claims that the archival data is available with the other; several months of searching have yielded no results.

Fortunately, in the Czech Republic, statistical reports are provided by the Association of Car Importers, where it was possible to find monthly data on both new registrations and scrapped cars, at least broken down by brand and model.

The data obtained from Slovakia and the Czech Republic allow at least a basic analysis of the development of scrapped cars in Slovakia and to measure the impact of the scrappage scheme on the increase in scrapped cars. It also allows a comparison of the impact of the scrappage scheme on the increase or decrease in interest in certain car brands (which is important in the context of the question of how much the domestic industry has been supported and how much imports have been supported). Further analyses could not be carried out due to lack of data.

### **Input data for the synthetic control variable**

As an input to the basic difference-in-difference model for the different European countries, we use a synthetic control variable. For this purpose, we use the same data as Lüth (2021), but for an extended number of countries. The advantage of this approach is a more direct comparability with previous research and with the OECD countries analysed by Lüth.

In order to obtain a more robust control for the countries in our dataset, a set of covariates is obtained that includes GDP per capita (PPP, quarterly, seasonally adjusted), unemployment rate (monthly), 3-month short-term interest rate (monthly), industrial production index (monthly, seasonally adjusted, with 2015 as base year), consumer price index (monthly, base year 2015), all obtained from the OECD Main Economic Indicators database. In addition, following Lüth (2021), we also include the World Bank's CO<sub>2</sub> per capita measure (annual) from the World Development Indicators database. Data with a frequency lower than monthly are linearly imputed for our purposes.

These six indicators are intended to broadly capture each country's current economic situation and prospects, as well as the level of commitment to environmental protection, all of which are expected to influence the volume of car registrations and scrapping rates.

## **5.3 Data processing**

### **Method used**

The two most commonly used methods for policy impact analysis are the difference-in-differences method and the more recent synthetic control method developed by Abadie, Diamond and Hainmueller (2010). The basic idea behind the latter is to construct a synthetic control variable that is as close as possible to the treated variable of interest outside the treatment period by assigning weights to observations from a pool of untreated units (in our case, countries without a scrappage scheme), and then to observe whether or not the treated and constructed synthetic variables continue to converge during the treatment.

In analysing the impact of scrappage schemes across European countries, we combine both methods, resulting in a model that benefits from both the analytical simplicity and clarity of the difference-in-differences approach and the data-driven approach of the synthetic control

method. Thus, we obtain the inferential result of a difference-in-differences model with multiple treatment periods, while avoiding one of the major methodological weaknesses of the common trend assumption by using the constructed synthetic controls for each treated country as input.

In practice, this means that we do not select a specific control group for each country (e.g. the Czech Republic as a control for Slovakia), but rather a statistically rigorous weighted average of countries without scrapping policies, obtained using the synthetic control method, whose development prior to the treatment period is closer to the treated country than any other individual country. It also allows us to take into account various socio-economic factors in the construction of the synthetic variable itself.

The synthetic control method used here works as follows. Take a sample of  $J + 1$  countries. For simplicity, only the first country ( $j=1$ ) introduces a scrapping policy, while the remaining countries remain as controls. The synthetic control variable for the country in question is calculated as a weighted average of all units  $j=2, \dots, J+1$ .  $T$  indicates the number of time periods.

If we denote the registrations of country  $j$  without a scrapping policy in period  $t$  as  $Y_{jt}^N$  and  $Y_{jt}^I$  as the outcome affected by the introduction of the scrapping policy in country  $j$  in period  $t$ , the impact of the treatment intervention in the period after the introduction of the scrapping policy can be expressed as (since these two outcomes should be the same in the period before the intervention):

$$v_{jt} = Y_{jt}^I - Y_{jt}^N$$

Our main goal is to identify the most fitting weighted average of countries without the scrapping policy to create the synthetic control variables. Following Abadie and Gardeazabal (2003), we defined the required weights as  $w = \{w_2, w_3, \dots, w_{j+1}\}$ , while:

$$\sum_{j=2}^{J+1} w_j = 1$$

where  $j = 2, \dots, J + 1$ . Therefore, the estimators of  $v_{jt}$  and  $Y_{jt}^N$  can be denoted as:

$$\hat{v}_{jt} = Y_{jt}^I - \hat{Y}_{jt}^N$$

$$\hat{Y}_{jt}^N = w_2 Y_{2t} + \dots + w_{j+1} Y_{j+1,t}$$

The weights  $w_2, \dots, w_{j+1}$ , we choose so that to minimise:

$$v_1 (X_{11} - w_2 X_{12} - \dots - w_{j+1} X_{1,j+1})^2 + \dots + v_k (X_{k1} - w_2 X_{k2} - \dots - w_{j+1} X_{k,j+1})^2$$

We opt for the cross-validation technique as in Opatrný (2021), leading us to find weights that would minimise the prediction error. These are obtained by the minimization of the root mean square predicted error (RMSPE):

$$RMSPE = \left( \frac{1}{T_0} \sum_{t=1}^{T_0} \left( Y_{1t} - \sum_{j=2}^{J+1} w_j * Y_{jt} \right)^2 \right)^{\frac{1}{2}}$$

In order to obtain good results, this method requires several conditions to be met. Apart from the need for a balanced panel, countries with similar treatment should not be included in the data to avoid biased results. Similarly, the countries that serve as the control pool should have some similarity in performance with the treatment unit to obtain a good fit. It should also be taken into account that the control countries could also be affected by the scrapping policy in a neighbouring country, if many people buy or sell cars across borders and the policy allows this.

In the table in Annex 3, we therefore test the robustness of the synthetic variables for each country by looking at the weights assigned to each control country within the pool of controls. If a country is overwhelmingly represented by only one country, the results will be less robust.

We then construct a difference-in-differences model with multiple treatment periods, using the synthetic controls as inputs, to assess the effect of the scrapping policy, taking into account the anticipation period and the pull-forward period.

Using the OLS method for each of the countries  $i \in \{1, \dots, N\}$  with a scrapping scheme, we run the following model:

$$Y_{it} = \beta_0 + \beta_1 * country_i + \beta_2 * P1_{it} + \beta_3 * P2_{it} + \beta_4 * P3_{it} + \delta_1 * DID1_{it} + \delta_2 * DID2_{it} + \delta_3 * DID3_{it} + \varepsilon_{it},$$

with a set of dummy variables, where  $country_i = 1$  for the treated country  $i$ , and is zero otherwise,  $P1_{it}$  is the indication that the current period  $t$  is the anticipation period for country  $i$ ,  $P2_{it}$  similarly denotes the treatment period and  $P3_{it}$  the pull-forward period.  $DID1_{it}$ ,  $DID2_{it}$  and  $DID3_{it}$  are the difference-in-differences covariates of interest between  $country_i$  and  $P1_{it}$ ,  $P2_{it}$  and  $P3_{it}$  respectively.  $Y_{it}$  are the new registrations in country  $i$  in period  $t$ .

In consequent models where we focus on the comparison between Slovakia and Czechia, we continue using the difference-in-differences method without the input of the synthetic variables, as we discuss further below.

### Treatment periods

As mentioned above, one of the original benefits of this paper is the inclusion of both anticipation and pull-forward periods in the model, and their identification for each country separately.

Therefore, for the purpose of statistical analysis, the time-series data were divided into five periods:

- A. The period during which the public did not yet expect the introduction of a scrappage scheme and therefore their investment and consumption behaviour was not influenced by this policy.
- B. The anticipation period, during which the public expected the imminent introduction of a scrappage scheme and could adjust their behaviour accordingly, in particular by delaying the scrapping of old vehicles and buying new ones.
- C. The treatment period, during which the scrappage premium was applied and citizens registered new vehicles purchased under this policy.
- D. The pull-forward period during which some citizens would have purchased a new car under otherwise identical circumstances, but the scrapping premium actually accelerated the purchase.
- E. The period in which the effect of the scrapping premium was exhausted and no longer influenced behaviour.

The duration of each period was not evident beforehand and required interpretation of the available data. We proceeded as follows:

**Anticipation period:** It can be assumed that this period started at the latest when the local government announced the introduction of the scrappage scheme (or in the month following the announcement) and lasted until the start of the treatment period. However, it can also be assumed that the public expected the scrappage scheme to be introduced earlier, given the public debate that preceded the approval and implementation of the scrappage scheme. This public discussion was in some cases very short (such as in Slovakia, where it lasted less than a month), but in others lasted several months (especially in countries that were among the first to introduce a scrappage scheme). To do this, we used Google Trends to analyse the intensity of searches for the scrappage topics and for the term “scrappage” in the local language. In the end, we determined the start of the anticipation period based on the first method (the date of the policy announcement) and adjusted it only if Google Trends showed significant activity earlier.

**Treatment period:** In most cases, of course, the start of this period was determined by the official start of the scrappage scheme in the country concerned. However, in some cases it is reasonable to assume that the treatment effect will not be seen until the following month (typically when the initiative started in the middle of the month, as in Germany; it took some time to fulfil all the conditions and register a new car). Setting the end of the period was even less obvious. Governments usually decided that the scrappage scheme would end either on a specific date or when the funds were exhausted. (For example, in Austria, the scrappage scheme was potentially valid from April 2009 until December 2009, but the funds were exhausted in July 2009). The allocation of funds was linked to the date of purchase of a new car, not to its delivery. In some countries (e.g. Slovakia), a delay of several months was reported in the delivery of the most popular brands and models under the scrappage scheme. As our data are linked to the date of registration of a new car and not to the date of sale, it was necessary to determine the end of the treatment period accordingly. We did this by first

setting the end of the period at the official planned end of the period and then shortening this end if there was a decline in new registrations before then (i.e. it was clear that the scrappage effect had already worn off).

**Pull-forward period:** Unlike the previous periods, this period cannot be determined on the basis of official announcements. One option would have been to determine the length of this period individually for each country, based on how long a decline in new registrations (compared to the synthetic reference variable) was observed. However, this method would not be correct as it would not lead to an unbiased measurement of the effect; rather it would mean selecting data to maximise the effect. We therefore decided, on the one hand, to base the length of this period on what the data indicated, but, on the other hand, to fix this length for all countries. We reasoned that the time horizon over which consumers are willing to consider accelerating the purchase of a new car is not significantly related to cultural differences or a country's GDP. In the end, we decided to set this period at two months.

The table below gives an overview of the length of the anticipation, treatment and pull-forward periods for each country, together with an explanation.

**Table 9: Temporal structure of the periods included in the model**

Country	Local Name	Anticipation period	Treatment period	Pull-forward period
Austria	Ökoprämie	02–03/2009	04/2009–11/2009	12/2009–01/2010
	<p><b>Note on the anticipation period:</b> The initiative was officially announced in 01/2009. Google Trends results show an increase in searches for scrappage in the second half of January 2009, which we do not expect to be reflected in new registrations until February.</p> <p><b>Note on treatment period:</b> The initiative was valid from 1 April to 31 December 2009. However, the funds were exhausted on 8 July 2009. The data show that although most new cars were registered by July, the effect lasted until November 2009.</p>			
Cyprus	απόσυρση παλαιών οχημάτων	12/2007	01/2008–07/2008	08–09/2008
		01/2009	02/2009–09/2009	10–11/2009
<p>06/2010</p> <p>07/2010–08/2010</p> <p>09–10/2010</p> <p><b>Note on the anticipation period:</b> Due to lack of data, we expect only a one-month anticipation for all three waves of the scheme.</p> <p><b>Notice: Due to the lack of data for the construction of the synthetic variable, Cyprus was eventually excluded from the model and no statistical analysis was performed for it.</b></p>				
France	Prime à la Casse	12/2008	01/2009–12/2010	01–02/2011
	<p><b>Introductory note:</b> In France, the scrappage scheme has been in force in one form or another since December 2007 to date. However, in 2008–2010, the scrappage scheme was temporarily adjusted and financial incentives were increased in the context of the automotive sales crisis. Our analysis therefore focuses on assessing the impact of this period only.</p> <p><b>Note on the anticipation period:</b> The scrappage scheme was announced on 4 December 2008. It seems that the details of the stimulus package, including the scrappage scheme, were not</p>			



	<p>known to the public in advance. We found the first mentions in the media on 2 December 2008 (which is consistent with the Google Trends results). This is not only why we do not expect the anticipation period to start in 11/2008, but also why we consider 12/2008 to be part of the anticipation period.</p> <p><b>Note on the treatment period:</b> The increased scrapping incentive was introduced on December 4, 2008. Initially, it was planned to last until December 31, 2009. In late 2009, it was extended until December 31, 2010 with a gradually decreasing premium (initial €1,000 decreased to €700 in 1/2010, and €500 in 7/2010).</p>			
Germany	Umweltprämie, Abwrackprämie	11/2008–01/2009	02–11/2009	12/2009–01/2010
	<p><b>Note on the anticipation period:</b> The idea was born in 10/2008. It was publicly discussed in 11–12/2008 and launched in mid-January 2009.</p> <p><b>Note on the treatment period:</b> The initiative was valid from 14 January 2009 until 31 December 2009. However, the funds were exhausted on 2 September 2009. The data show an increase in registrations until November 2009.</p>			
Greece	1) τέλους ταξινόμησης 2) διάλυσης	03–04/2009 10/2009	05–08/2009 11/2009	09/2009 12/2009
	<p><b>Introductory note:</b> In Greece, two different schemes were implemented in 2009 to promote the sale of new cars, but only the second involved the scrapping of old cars. Nevertheless, we have decided to include both in our model. The reason is that they both took place in the same year and had a similar purpose. So it makes sense to track their effectiveness together.</p> <p><b>Note on the anticipation period:</b> A plan to reduce car registration fees for four months was introduced and discussed in 03/2009. The initiative started at the beginning of 04/2009 (reflected in registration numbers in 05/2009). Then, seeing the decline in sales in 09/2009, the government introduced a car scrapping scheme at the end of 09/2009. However, the results in terms of car registrations were not visible until 11/2009 (similar to the lag in data observed in spring).</p> <p><b>Note on the treatment period:</b> The temporary reduction of registration fees applied from the beginning of April until 7 August 2009. The scrapping scheme was announced on 22 July and was valid from 28 September 2009 to 2 November 2009.</p> <p><b>Note on the pull-forward period:</b> In the case of Greece, it did not make sense to consider a two-month pull-forward period. Firstly, October 2009 (which would otherwise be included in a pull-forward period) should already be considered as an anticipation of the scrapping scheme. Second, the scrapping scheme lasted only one month, so it would not be appropriate to consider a two-month pull-forward period at the end of 2009.</p>			
Ireland	Scrapping	12/2009	01/2010–06/2011	07–08/2011
	<p><b>Note on anticipation period:</b> The scrapping scheme was announced in 12/2009. Google Trends also shows an increase in searches for the scrapping topic only in December.</p> <p><b>Note on the treatment period:</b> The scrapping scheme ran from 1 January 2010 to 31 December 2010 and has been extended until 30 June 2011.</p>			
Italy	Rottamazione	01/2009	02/2009–03/2010	04–05/2010
	<p><b>Introductory note:</b> Italy introduced its first scrapping scheme in 1997 and has run various schemes on and off since then. However, in 2009 there was a scrapping scheme linked to the economic crisis, which significantly increased the scrapping premium. Our analysis therefore focuses only on the impact of this increased premium.</p>			

	<p><b>Note on anticipation period:</b> The initiative was announced in 01/2009. Google Trends only shows an increase in searches for scrappage in January 2009.</p> <p><b>Note on the treatment period:</b> While the initiative ran from 7 February 2009 to 31 December 2009, new vehicles could be registered until the end of 03/2010.</p>			
Luxembourg	Verschrottungsprämie / Prime à la casse / Abwrackprämie	12/2008	01/2009–07/2010	08–09/2010
	<p><b>Note on the anticipation period:</b> Google Trends shows an increase in search intensity between 11/2008 and 12/2008.</p>			
Netherlands	Slooppremie, sloopregeling	04–05/2009	06/2009–04/2010	05–06/2010
	<p><b>Note on anticipation period:</b> The scheme was announced by the government on 25 March 2009. Google Trends shows a significant increase in search intensity in 04/2009.</p> <p><b>Note on the treatment period:</b> The scrappage scheme came into effect on 29 May 2009 and lasted until 21 April 2010.</p>			
Portugal	Abate de Veículos	07/2009	08/2009–12/2009	01–02/2010
	<p><b>Introductory note:</b> In Portugal, the scrappage scheme was in force from December 2000 until the end of 2010 (except for the first four months of 2010). Since then, other versions of the financial incentives have been in place until today. In our analysis, therefore, we only examine the effect of the temporary increase in the incentive in 2009.</p> <p><b>Note on the anticipation period:</b> The increased value of the scrappage scheme was announced to be effective from 08/2009. Google Trends shows an increase in searches since July 2009.</p>			
Romania	Prima de casare, Rabla		05-12/2005	
		04/2005	07-12/2006	01-02/2006
05-06/2006		05-12/2007	01-02/2007	
03-04/2008		06-12/2008	01-02/2008	
03-05/2008		04-12/2009	01-02/2009	
03/2009		03/2010-01/2011	01-02/2010	
03/2012		04-12/2011	02-03/2011	
03-05/2013		04-12/2012	01-02/2013	
<p><b>Introductory note:</b> In Romania, the car scrappage scheme was introduced in 2005 and has been repeated every year since. Therefore, our initial intention was to select only the period that was specifically designed to mitigate the effects of the economic crisis (similar to France, Portugal or Spain). In the case of Romania, however, no such period could be identified. We therefore decided to include all years in the model, taking advantage of the fact that the scrappage schemes in each year were not directly linked to each other. Therefore, it should be possible to ask how people behaved in the months when the scrappage scheme for that year was not yet in force.</p> <p><b>However, because of the different range of data compared to other countries, Romania was eventually excluded from the model and no statistical analysis was performed for it.</b></p> <p><b>Note on the anticipation period:</b> the scheme was launched in 2005. Although it was approved at the end of 2004, the increase in scrappage searches is not visible in Google Trends until April 2005. In 2006, the scheme was launched on 30 June; a noticeable increase in searches can be seen from May 2005. In 2007, there was noticeable search activity from the beginning of the</p>				

	<p>year, so we set the anticipation period in March (the first two months are the pull-forward period from last year). In 2008, search activity bottomed out at the beginning of March, but then started to increase, so we include the months from March onwards in the anticipation period. In 2009, the new scheme started at the end of March, so we include March as the lead-in period (which corresponds to the increase in search activity). In 2010, we do not consider an anticipation period, as the scheme did not run for only the first two months, which we consider to be an anticipation of the previous year, in line with our chosen methodology. For similar reasons, we do not consider an anticipation period for 2011. In 2012, the new scheme started at the end of March, and we have therefore included March as an anticipation period (corresponding to the increase in search activity). In 2013, the search intensity started to increase at the beginning of March.</p> <p><b>Note on the treatment period:</b> in 2005, the scrappage scheme was exhausted by the end of November 2005, so we added December. In 2010, not all scrappage vouchers were redeemed at the end of the year and their validity was extended until the end of January 2011; we therefore assume that some of the new car purchases were still made in January 2011.</p>			
Slovakia	Šrotovné	02/2009	03–09/2009	10–11/2009
	<p><b>A note on the anticipation period:</b> The scrappage scheme was announced at the end of February 2009 (while in the first half of February the Slovak government rejected the idea). Google Trends shows no results yet in January 2009.</p> <p><b>Note on the treatment period:</b> The scrappage scheme was effective in March and April 2009, with the possibility to register a new car until the end of 2009. The data show that although most new cars were registered by July, the effect lasted until September 2009.</p>			
Spain	Prever (1997–2007), VIVE (2008–2009), Plan2000e (2009–2010), PIVE (2012–2016) <sup>5</sup>	07/2008 10/2012	01/2005–12/2007 08/2008–06/2010 11/2012–12/2013	01–02/2008 07–08/2010
	<p><b>Introductory note:</b> Spain has had a car scrappage scheme in one form or another since 1994. However, between 2008 and 2013 there were three scrappage schemes linked to the crisis in car sales. (The third continued after 2013, but this is outside the time horizon of our analysis). As all the schemes in 2008–2013 were linked to the economy, we have decided to include all of them in the analysis.</p> <p><b>Note on the anticipation period:</b> The VIVE plan was approved on 27 June 2008. This corresponds to the increased intensity of Google Trends searches at the end of June and beginning of July. The plan itself was launched one month later. The PIVE plan was approved on 28 September 2012. This corresponds to the increased search intensity according to Google Trends in September/October. The plan itself was launched in the second half of October.</p> <p><b>Note on the treatment period:</b> The Prever plan ran from 1997 until the end of 2007. The VIVE plan started accepting applications in 08/2008 and ran out of funds in 05/2009. It was immediately followed by the Plan 2000e from 05/2009, which was exhausted in 06/2010. The PIVE Plan only started in the second half of October and therefore we only started the treatment period in November 2012. Plans PIVE 2 to PIVE 4 were directly linked. (The following phases of the PIVE plan are outside our research period.)</p>			

<sup>5</sup> The Spanish word for scrapping is “desguace”. However, in the context of the scrappage schemes, the names of the individual schemes tended to be used directly in documents and on the internet.

	Scrappage	04/2009	05/2009–03/2010	04–05/2010
<b>United Kingdom</b>	<p><b>Note on anticipation period:</b> The scrappage scheme was announced in April 2009. Google Trends also shows increased search intensity in April 2009.</p> <p><b>Note on the treatment period:</b> The scrappage scheme ran from 18 May 2009 to the end of March 2010.</p>			

## 5.4 Results

In this section we present the results of the statistical analysis using the above defined data and methods. These results are further elaborated also in the Discussion section.

### **Q1: Did scrappage schemes affect the number of new registrations in individual European countries?**

The following table shows the results of the difference-in-differences analysis, where we compared the evolution of new car registrations in a given country with the synthetic variable, using indexed values for new registrations with January 2005 as the base month for easier comparability. The abbreviation DID1 refers to the difference-in-differences calculations for the anticipation period (pre-policy), DID2 for the treatment period (policy) and DID3 for the pull-forward period (post-policy) defined for each country in the previous section.

Notice: Unfortunately, for Cyprus and Romania it has not yet been possible to obtain all the data needed to construct the synthetic variable (or standardised data of the same scope and quality as for the other countries). For this reason, these two countries have not been included in the model. The following analysis and conclusions are therefore limited to the other twelve countries.

No statistical significance was found for the anticipation period (pre-policy) and for the pull-forward period (post-policy) in any of the countries analysed. However, the treatment period (policy) proved to be statistically significant for several countries, including Austria, Germany, Greece, Italy, Luxembourg, Slovakia, while on the borderline of acceptable significance are Portugal and Spain. In other words, in all these countries the introduction of the scrapping premium had a positive effect on the number of new car registrations compared to countries where the scrapping premium was not introduced. On the other hand, in France, Ireland, the Netherlands and the United Kingdom, no statistical significance was found during the treatment period.

It is also notable that in many cases the coefficients for the anticipation period (pre-policy) and the pull-forward period (post-policy) are negative, implying that in these periods the number of new car registrations was on the contrary negatively influenced by the scrappage scheme. However, the differences did not prove to be statistically significant.

**Table 10: Comparison of the number of new car registrations across selected European countries (country comparison with the synthetic variable, difference-in-differences)**

	<b>Intercept</b> (SD) (t-value)	<b>Pre-Policy</b> (SD) (t-value)	<b>Policy</b> (SD) (t-value)	<b>Post-Policy</b> (SD) (t-value)	<b>Country Variable</b> (SD) (t-value)	<b>DID1</b> Pre-Policy (SD) (t-value)	<b>DID2</b> Policy (SD) (t-value)	<b>DID3</b> Post-Policy (SD) (t-value)	<b>R2</b>	<b>Adj-R2</b>
<b>Austria</b>	<b>114.19</b> 1.76 64.91***	<b>-15.83</b> 12.32 -1.29	<b>-16.178</b> 6.34 -2.55*	<b>-10.94</b> 12.31 -0.89	<b>-1.76</b> 2.49 -0.70	<b>0.10</b> 17.40 0.01	<b>28.73</b> 8.97 3.20**	<b>-15.46</b> 17.40 -0.89	0.08	0.0532
<b>France</b>	<b>109.71</b> 1.86 58.83***	<b>0.02</b> 16.89 0.00	<b>4.77</b> 3.90 1.22*	<b>0.86</b> 12.01 0.07	<b>-7.91</b> 2.64 -2.99**	<b>-8.18</b> 23.88 -0.34	<b>9.05</b> 5.52 1.64	<b>16.13</b> 16.99 -0.95	0.10	0.0653
<b>Germany</b>	<b>131.68</b> 2.02 65.17***	<b>-19.48</b> 13.99 -1.39	<b>-18.56</b> 6.52 -2.84**	<b>-22.62</b> 14 -1.62	<b>-0.19</b> 2.87 -0.10	<b>2.679</b> 19.80 0.14	<b>49.98</b> 9.03 5.54***	<b>-9.90</b> 19.80 -0.50	0.19	0.1623
<b>Greece</b>	<b>66.95</b> 2.31 28.98***	<b>-12.52</b> 13.40 -0.93	<b>-21.72</b> 10.49 -2.07*	<b>-26.81</b> 16.34 -1.64	<b>-19.48</b> 3.27 -5.96***	<b>6.50</b> 19.00 0.34	<b>51.61</b> 14.80 3.48***	<b>13.44</b> 23.10 0.58	0.18	0.1514
<b>Ireland</b>	<b>75.89</b> 2.80 27.15***	<b>-45.42</b> 26.23 -1.73*	<b>-14.24</b> 6.75 -2.11*	<b>-25.48</b> 18.65 -1.37	<b>-48.76</b> 3.95 -12.33***	<b>19.09</b> 37.09 0.52	<b>11.10</b> 9.55 1.16	<b>7.90</b> 26.37 0.30	0.47	0.4501
<b>Italy</b>	<b>89.28</b> 1.94 46.07***	<b>-17.21</b> 18.59 -0.93	<b>-15.52</b> 5.31 -2.93**	<b>5.07</b> 13.22 0.38	<b>-14.24</b> 2.74 -5.19***	<b>16.06</b> 26.30 0.61	<b>29.39</b> 7.51 3.92***	<b>-4.19</b> 18.70 -0.22	0.14	0.1091
<b>Lux.</b>	<b>119.39</b> 2.26 52.88***	<b>-35.58</b> 21.06 -1.69*	<b>-17.76</b> 5.31 -3.35*	<b>0.07</b> 14.98 0.01	<b>-9.96</b> 3.19 -3.12**	<b>-1.06</b> 29.80 -0.00	<b>21.25</b> 7.51 2.83**	<b>-32.58</b> 21.20 -1.54	0.12	0.0881
<b>Netherlands</b>	<b>77.09</b> 1.74 44.32***	<b>-13.27</b> 11.99 -1.11	<b>-14.34</b> 5.35 -2.68	<b>8.10</b> 11.99 0.67	<b>-19.99</b> 2.46 -8.13***	<b>-0.74</b> 17.00 -0.00	<b>6.46</b> 7.56 0.85	<b>-3.46</b> 17.00 -0.20	0.29	0.2656
<b>Portugal</b>	<b>101.45</b> 2.37 42.75***	<b>-20.21</b> 22.51 -0.90	<b>1.37</b> 5.93 0.23	<b>-0.54</b> 22.51 -0.02	<b>-17.75</b> 3.36 -5.29***	<b>40.30</b> 31.80 1.27	<b>19.68</b> 8.38 2.36*	<b>-3.15</b> 31.80 -0.10	0.15	0.1196
<b>Slovakia</b>	<b>129.99</b> 2.28 57.09***	<b>-6.51</b> 22.67 -0.29	<b>3.53</b> 8.82 0.40	<b>3.77</b> 16.10 0.23	<b>7.75</b> 3.22 2.41*	<b>-45.65</b> 32.00 -1.40	<b>66.68</b> 12.50 5.35***	<b>-36.49</b> 22.80 -1.60	0.3	0.2737
<b>Spain</b>	<b>87.52</b> 5.50 15.90***	<b>5.26</b> 21.67 0.24	<b>6.55</b> 6.51 1.01	<b>11.56</b> 15.81 0.73	<b>-18.62</b> 7.79 -2.39*	<b>5.22</b> 30.65 0.17	<b>22.52</b> 9.20 2.45*	<b>2.99</b> 22.36 0.13	0.10	0.0661
<b>UK</b>	<b>109.74</b> 4.297 25.54***	<b>-24.52</b> 41.88 -0.56	<b>-21.39</b> 13.28 -1.61	<b>-3.24</b> 29.77 -0.11	<b>-9.09</b> 6.08 -1.50	<b>-3.58</b> 59.23 -0.06	<b>20.56</b> 18.78 1.10	<b>-14.23</b> 42.10 -0.34	0.02	0.008

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

We further verified the results through f-tests for joint significance of the difference-in-differences variables for all analysed periods in each country. In this case, France, Ireland, Netherlands and the United Kingdom appeared to be statistically insignificant. The strongest statistically significant differences were again found especially in Germany and Slovakia, followed by Greece and Italy.

This means that in the case of the former countries, the overall effect of the scrapping policy was not found significant – even if the treatment period itself was, it was offset by the

opposite effect of the anticipation and pull-forward periods. On the other hand, in the latter countries, we find evidence that the overall effect of the policy was non-zero, meaning that for example in Slovakia, even accounting for the anticipation and pull-forward periods, we observe a positive total impact of the policy on new registrations.

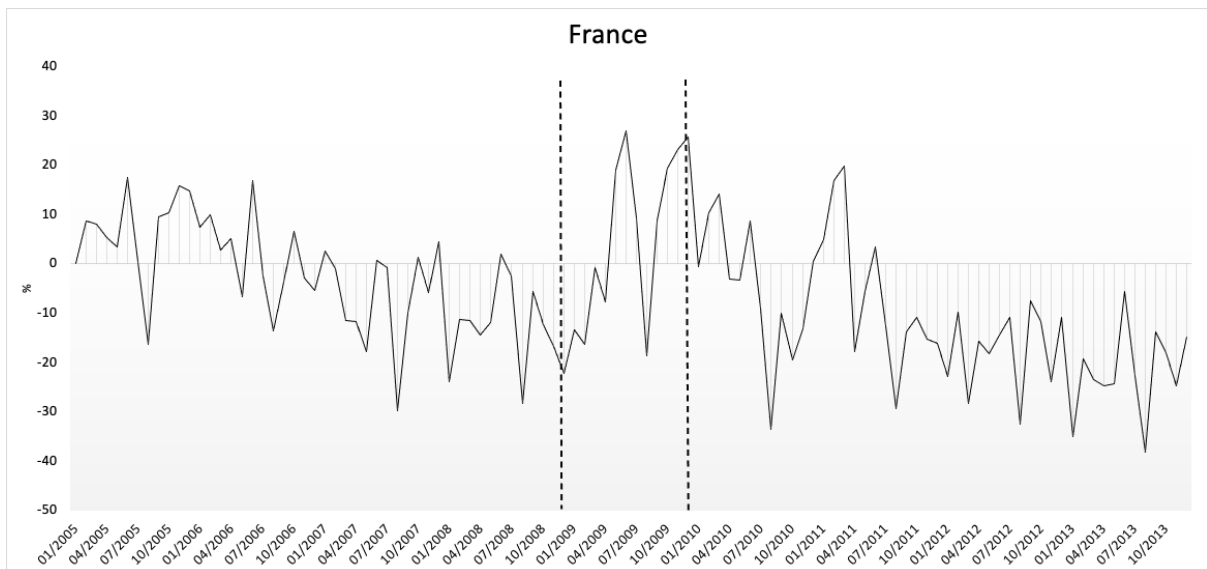
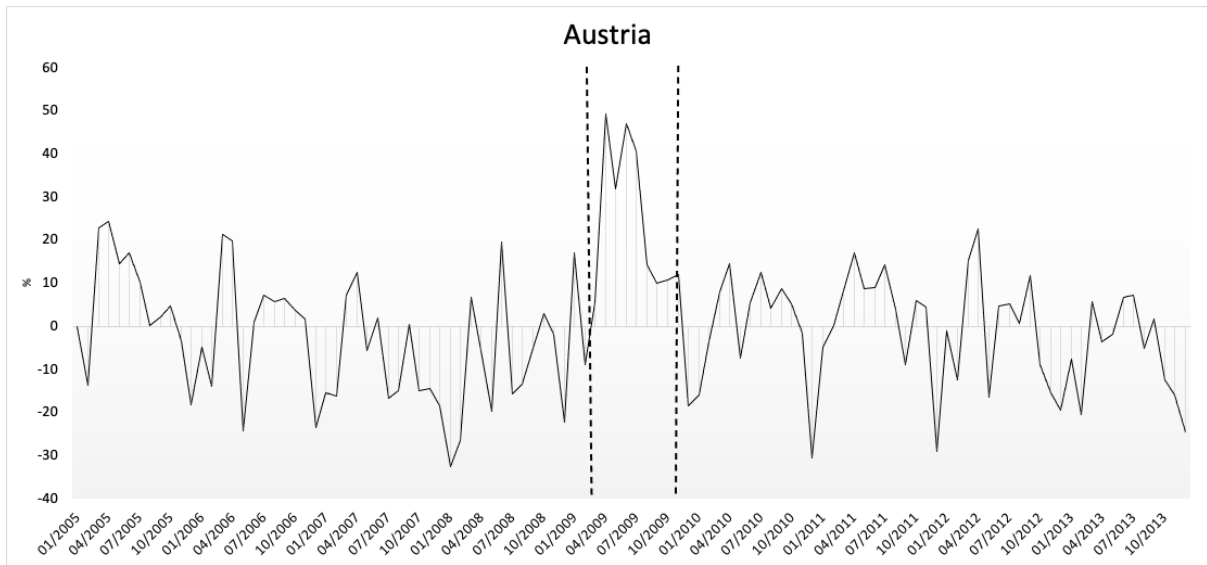
**Table 11: F-test for joint significance of DID1, DID2, DID3**

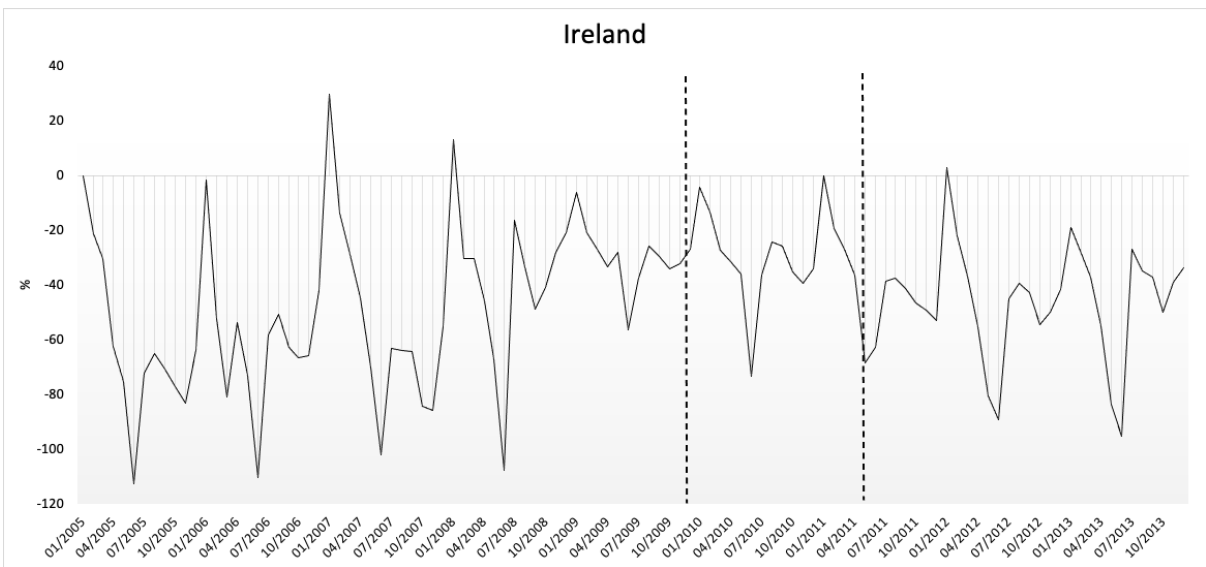
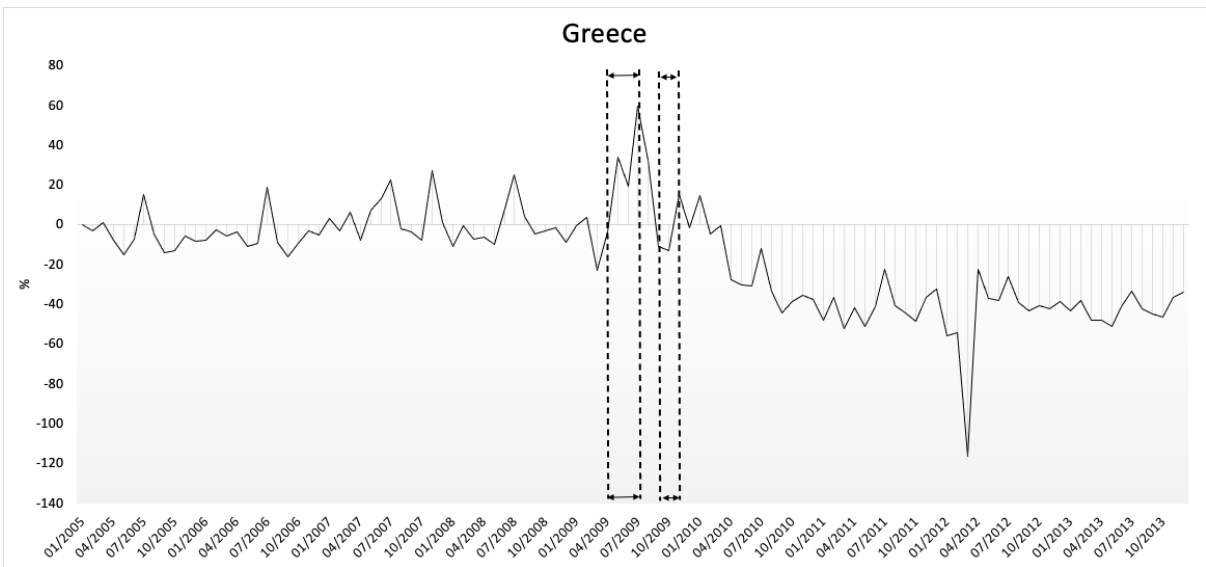
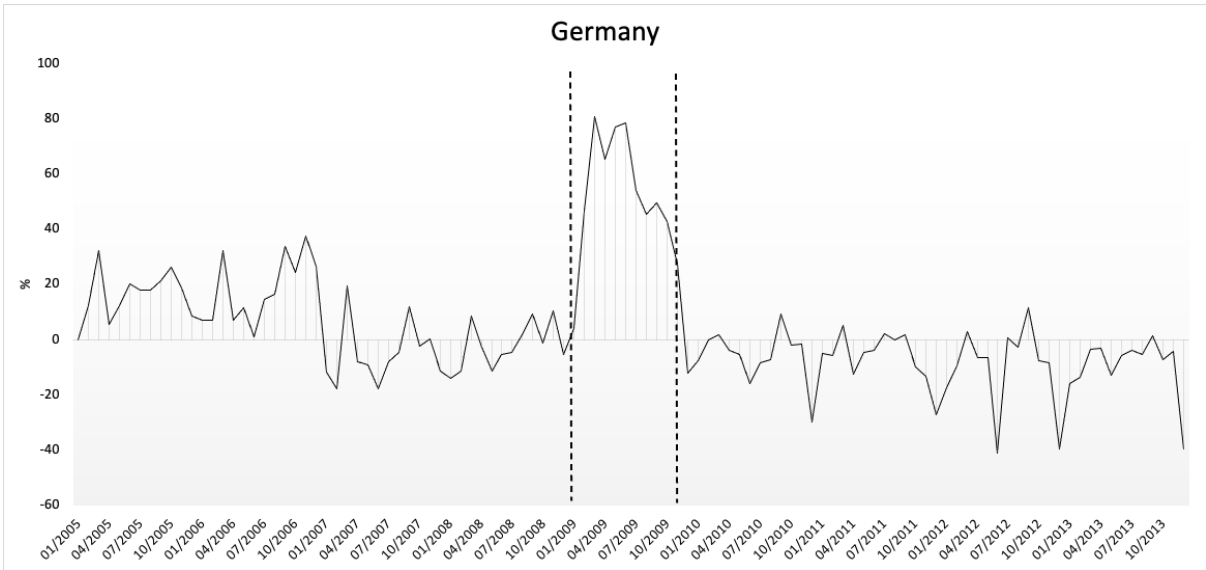
	F-statistic	P-value
<b>Austria</b>	3.7652	0.0116*
<b>France</b>	1.1908	0.3143
<b>Germany</b>	10.4150	0.0001***
<b>Greece</b>	4.1262	0.0072**
<b>Ireland</b>	0.5381	0.6567
<b>Italy</b>	5.2451	0.0017**
<b>Lux.</b>	3.6685	0.0132*
<b>Netherlands</b>	0.4265	0.8503
<b>Portugal</b>	2.3065	0.0777*
<b>Slovakia</b>	11.3970	0.0001***
<b>Spain</b>	2.1624	0.0936*
<b>UK</b>	0.4533	0.7152

*Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \**

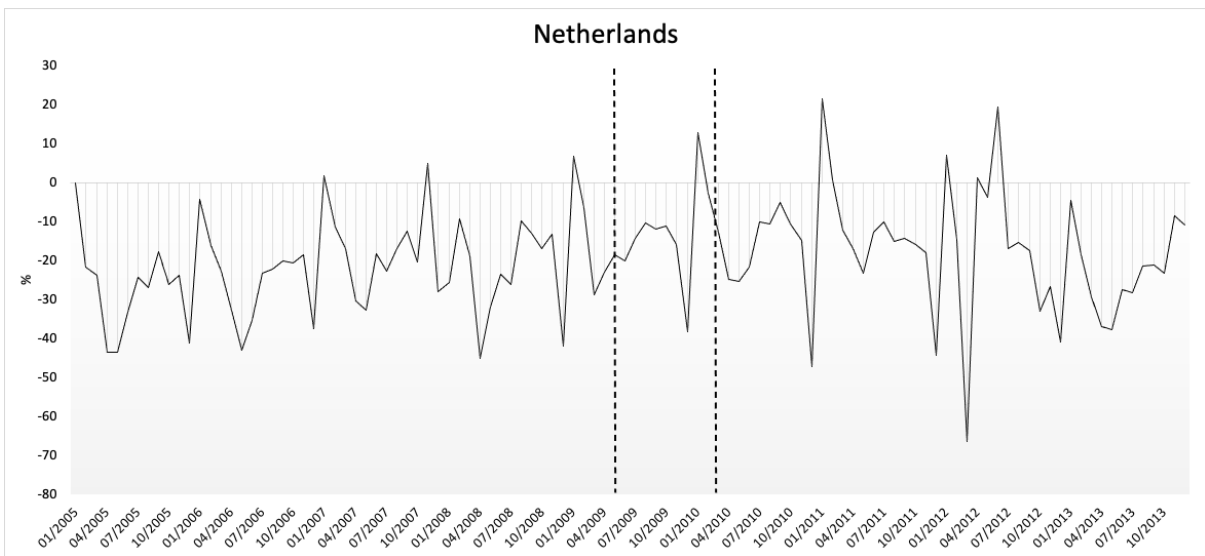
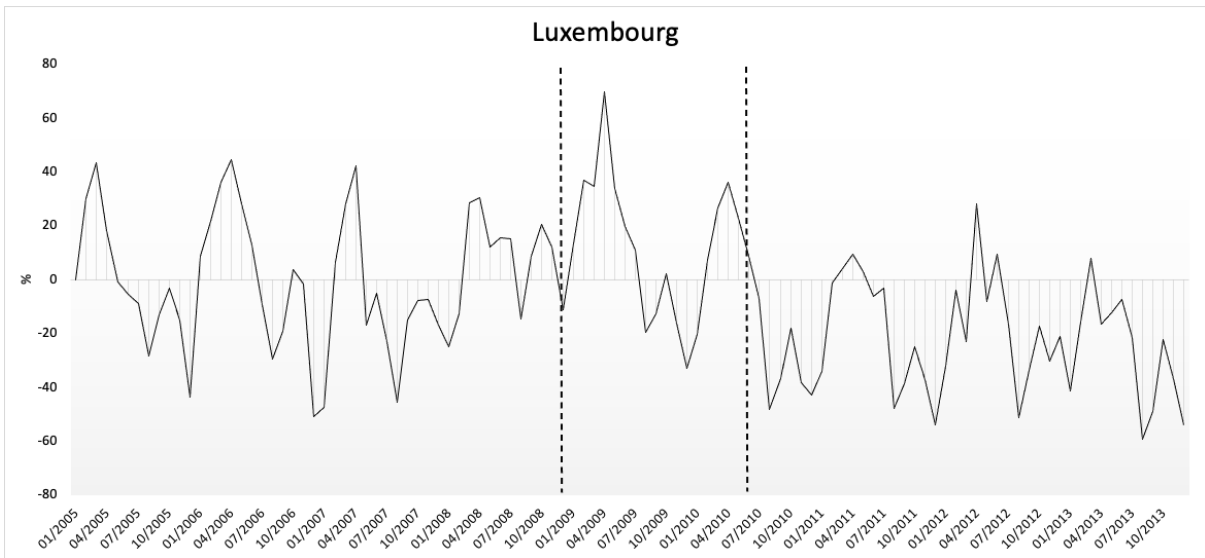
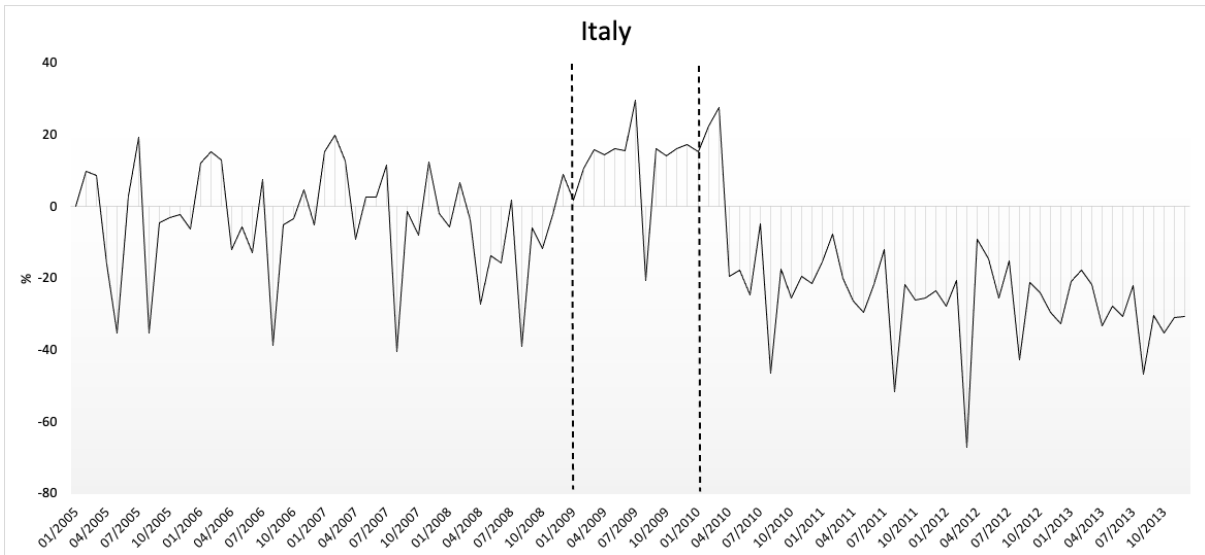
The series of figures below is a graphical representation of our analysed data. The curve in each of the graphs expresses the relative difference in the number of new passenger car registrations in a given country on the one hand, and within the synthetic variable (the simulation of comparable country) on the other hand. Dashed vertical lines are indicating the treatment (policy) periods (in the case of Greece and Spain, there are more than one treatment periods involved in the analysis).

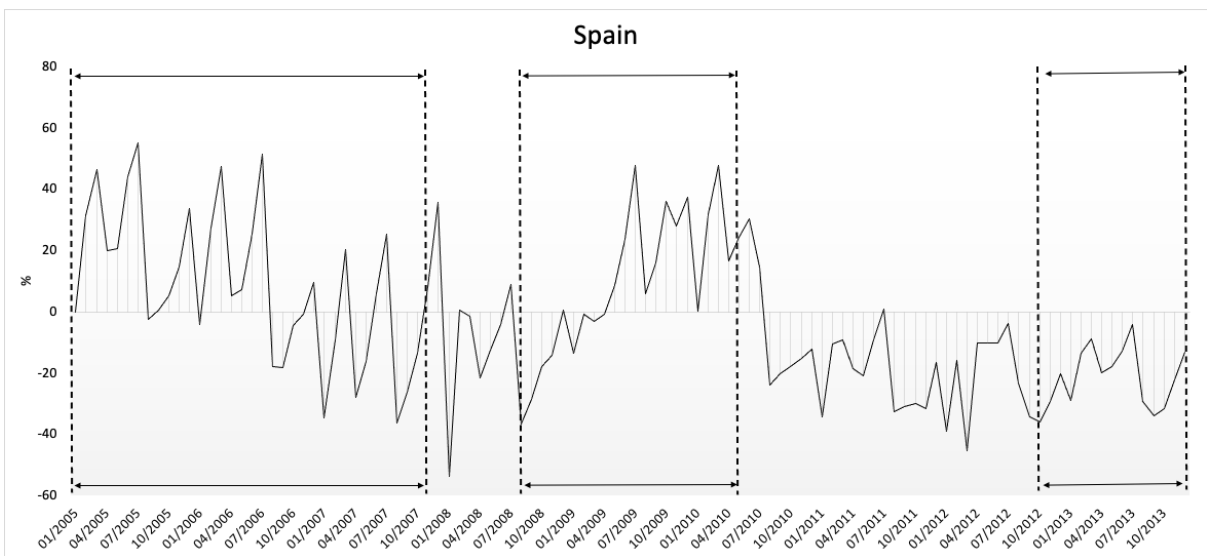
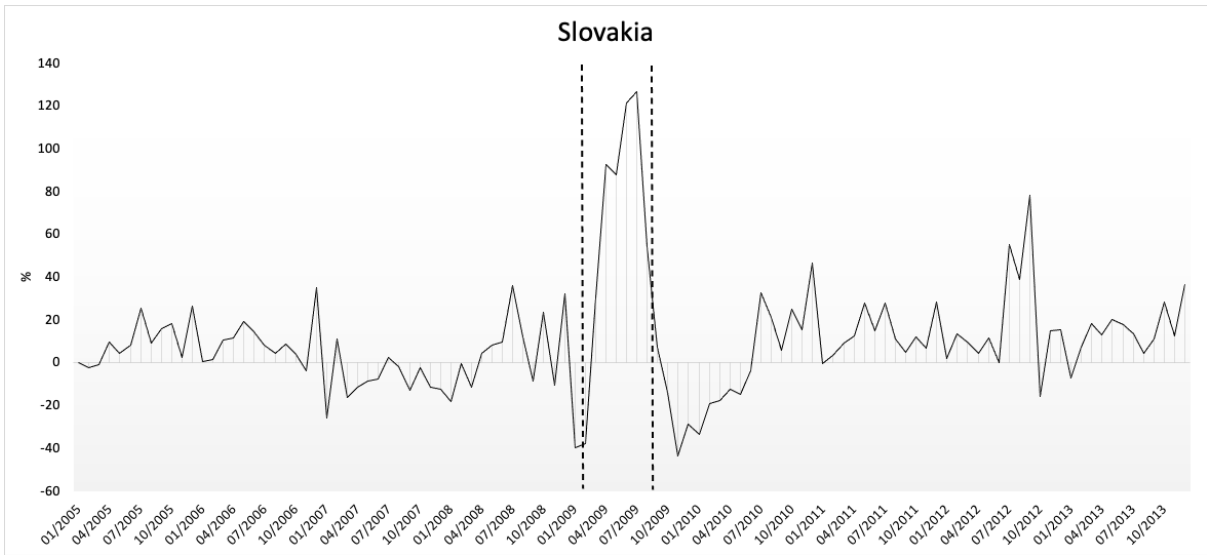
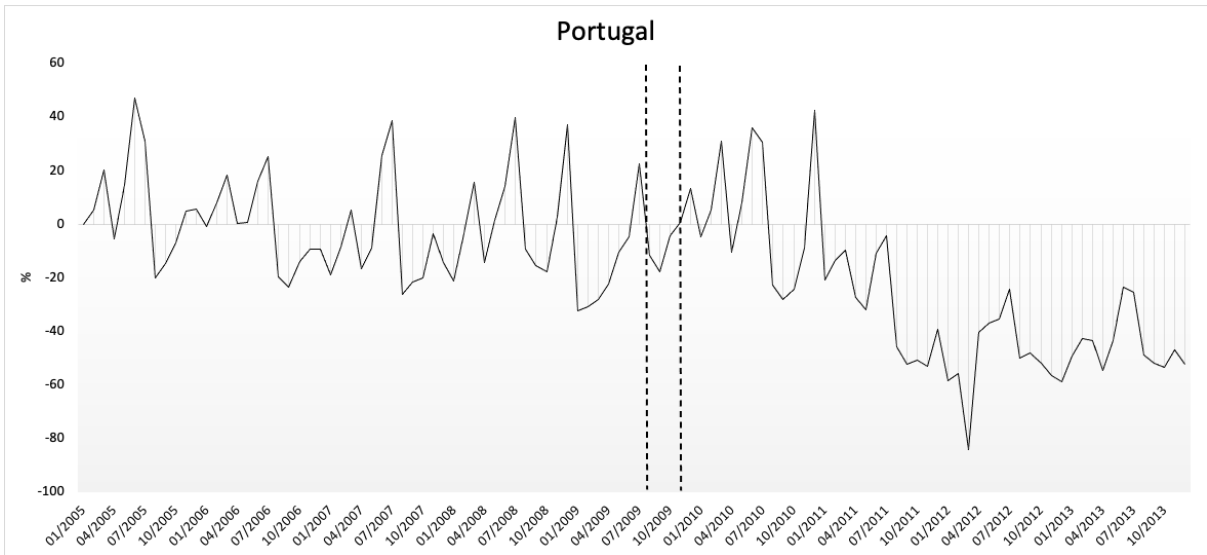
**Figure 14: Differences (gaps) in the number of new passenger car registrations (country comparison with the synthetic variable, difference-in-differences)**

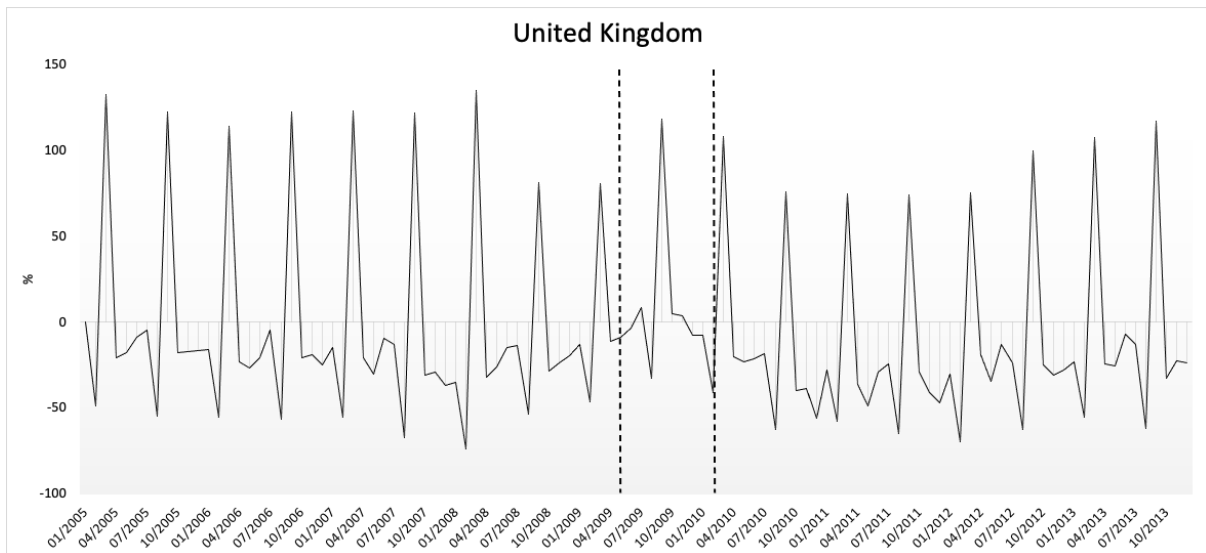












**Q2: Did the car scrappage scheme in Slovakia affect different brands in different ways with regard to new passenger car registrations?**

Despite the previously described comparison of the development of the number of new car registrations in Slovakia with its synthetic variable, we performed a similar difference-in-differences analysis again between Slovakia and Czechia. Although in this case the model is as expected slightly less statistically significant than in the case of the comparison with the synthetic variable, a strong result for the treatment period (policy) is evident as well, and the overall difference when using only Czechia as the control group compared to the model with the synthetic variable is not too large.

The results of the calculation show that the scrappage scheme in Slovakia positively influenced the development of the number of new car registrations compared to Czechia. The coefficients in both remaining periods are negative, but the differences did not prove to be statistically significant. Overall, this analysis shows that while we do not use the synthetic control method in the following in-depth analysis of the brands and age of cars, and rely on the comparison to Czechia as the control group, our results do not suffer for it. Furthermore, for easier interpretation, in the models below we rely on the number of registrations and deregistrations rather than indexed values.

**Table 12: Comparison of the number of new car registrations in Slovakia and Czechia (difference-in-differences)**

Intercept (SD) (t-value)	Pre-Policy (SD) (t-value)	Policy (SD) (t-value)	Post-Policy (SD) (t-value)	Country Variable (SD) (t-value)	DID1 Pre-Policy (SD) (t-value)	DID2 Policy (SD) (t-value)	DID3 Post-Policy (SD) (t-value)	R2	Adj-R2
140.927 2.41 58.475***	-20.98 23.98 -0.88	3.72 9.33 0.40	5.12 17.04 0.30	-3.18 3.41 -0.93	-31.19 33.91 -0.92	66.49 13.20 5.04***	-37.84 24.10 -1.57	0.2461	0.2208

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

**Table 13: F-test for joint significance of DID1, DID2, DID3**

F-statistic	P-value
9.8347	0.0001***

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

In order to compare which car brands were registered relatively more than others during the scrappage period in Slovakia, we again performed a difference-in-differences analysis between the Czech Republic and Slovakia, with the input data involving the monthly numbers of new passenger car registrations divided by individual manufacturer brands. In the context of data availability, the following brands were considered (36 in total): Alfa Romeo, Audi, BMW, Citroen, Dacia, Dodge, Fiat, Ford, Honda, Hyundai, Chevrolet, Chrysler, Iveco, Jaguar, Jeep, Kia, Lada, Lancia, Mazda, Mercedes, Mini, Mitsubishi, Nissan, Opel, Peugeot, Renault, Saab, Seat, Smart, Subaru, Suzuki, Škoda, Toyota, Volvo, Volkswagen, Ferrari.

Results of difference-in-differences analysis are stated in the table in Annex 4. They show that during the anticipation period (pre-policy), there was no statistically significant difference in the number of the new passenger car registration between Slovakia and Czechia with respect to any of the analysed car brands. However, during the treatment period (policy), some car brands showed a statistically significant difference, in which in few cases the coefficient is negative, indicating a decline in the number of registrations in Slovakia compared to the Czech Republic. This negative relationship was found to be significant for BMW, Dodge, Ford, Honda (at the 10 % significance level), Mercedes and Volvo. On the other hand, a statistically significant positive relationship, indicating that there was a higher number of registrations of these brands in Slovakia compared to the Czech Republic, was found for Citroen (at the 10 % significance level), Dacia, Lada, Peugeot, Renault, Seat and Toyota. Within the pull-forward period, a statistically significant difference is evident with a negative coefficient for car brands such as Citroen (at the 10 % significance level), Jeep, Mercedes, Nissan and Škoda.

### **Q3: Did the scrappage scheme in Slovakia affect the number of sales of locally produced cars?**

As mentioned above, Slovakia saw a significantly higher number of new registrations for car brands such as Citroën, Dacia, Lada, Peugeot, Renault, Seat and Toyota in comparison with Czechia. However, among these brands, only one joint manufacturer – PSA Peugeot Citroën – produced models such as Peugeot 207 and Citroën C3 Picasso during the period of 2008–2010 in Slovakia. The difference in the number of new passenger car registrations from other manufacturers such as Kia Motors or Volkswagen, which were also produced in Slovakia during 2008-2010, did not turn out to be statistically significant within the difference-in-differences analysis. It can therefore be noted that the scrappage scheme mainly supported car manufacturers producing cars outside Slovakia.

These findings are further discussed in a broader context in the Discussion section.

**Q4: Did the scrappage scheme in Slovakia affect the number of deregistered cars?**

Also in this case we rely on the difference-in-differences analysis involving Slovakia and Czechia, where we compared the monthly data on the number of deregistered passenger cars. However, the treatment period (policy) is a bit different than in case of comparing new car registrations, because the scrappage scheme in Slovakia was effective from March to April 2009 with the option to register a new car until the end of 2009. In other words, Slovakian consumers had to have their old car scrapped during March–April to get the bonus, but could buy a new one until the end of 2009. Consistent with our methodology, we assume the anticipation period to be the same as in the model for new registration (February 2009) and the pull-forward period being two months long (May–June 2009).

As the following table shows, the treatment period in Slovakia appeared to be positively affected by the introduction of the scrappage scheme compared to Czechia, in the sense that the number of deregistered cars increased. The result therefore also serves as a verification of the above stated analysis of the development of new passenger car registrations.

**Table 14: Comparison of the number of car de-registrations in Slovakia and Czechia (difference-in-differences)**

Intercept (SD) (t-value)	Pre-Policy (SD) (t-value)	Policy (SD) (t-value)	Post-Policy (SD) (t-value)	Country Variable (SD) (t-value)	DID1 Pre-Policy (SD) (t-value)	DID2 Policy (SD) (t-value)	DID3 Post-Policy (SD) (t-value)	R2	Adj-R2
11697.8 612.5 19.098***	14211.2 5478.3 2.594*	7873.2 3897.9 2.020*	2845.2 3897.9 0.730	-8803.9 866.2 -10.164***	-12690.1 7747.5 -1.638	12610.9 5512.5 2.288*	-1377.6 5512.5 -0.250	0.4766	0.4537

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

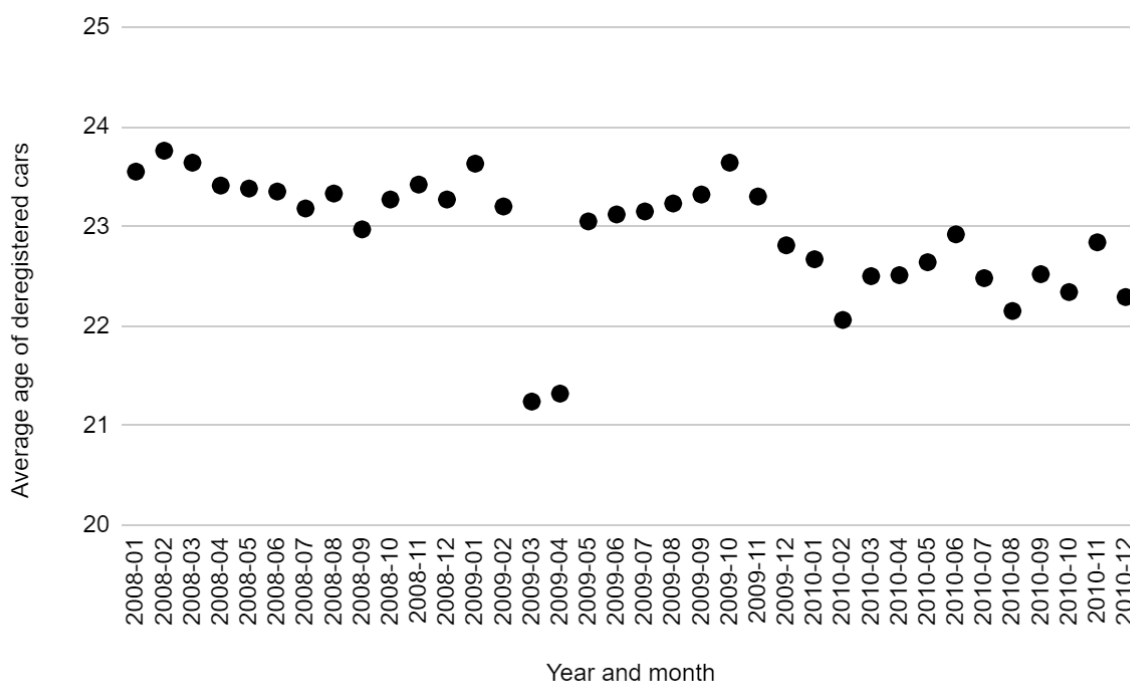
**Table 15: F-test for joint significance of DID1, DID2, DID3**

F-statistic	P-value
20.81	0.0001***

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

The detailed data also gave us an insight into the average age of deregistered cars. As the following figure shows, the average age of scrapped cars decreased considerably during the two months (03–04/2009) when the scrappage scheme was active.

**Figure 15: Average age of deregistered cars in Slovakia 2008–2010**



Source: Own creation.

## 6. Discussion

The number of passenger cars in the EU has increased from 203 million in 2006 to over 253 million in 2021, but the composition of the fleet has changed considerably due to slower renewal rates of passenger cars. This might have negative implications for the environment and public health as older vehicles tend to be less fuel-efficient and emit more pollutants than newer ones. However, the increasing share of electric and hybrid vehicles in the fleet, as well as the declining share of diesel vehicles, may offset these negative effects. The average CO<sub>2</sub> emissions of new passenger cars fell by almost 33% between 2006 and 2021, but achieving the proposed goal of zero emissions for all new cars in the future will require sustained reductions in emissions in the years to come.

Moreover, the number of end-of-life vehicles in the EU has fluctuated over the period of 2006–2020, with a peak of 7.7 million vehicles reported in 2009 due to the governments' scrapping incentives during the financial crisis. It is therefore appropriate to ask whether these facts, together with European green initiatives, will lead again to re-consideration of the scrappage schemes or similar schemes.

To add new contributions to the debate, we focused on two key aspects within this research – a thorough descriptive analysis of all available information relating to scrappage in all European countries combined with the statistical analysis. While previous analyses by other authors have focused on the number of new registrations, this paper also examines the effect

on monthly scrappage rates. This is a complementary approach to confirm the extent to which the scrappage scheme has had an impact on fleet renewal.

One reason for the difficulty to isolate the effect of the scrappage scheme with sufficient reliability seems to be the effect of seasonality. When constructing a synthetic variable, the effect of seasonality should be attenuated if the countries being compared are subject to similar seasonal fluctuations. For this reason, we did not seasonally adjust the data. However, it turned out that this did not completely remove the effect of seasonality. For example, in the case of Ireland or the United Kingdom, Figure 14 clearly shows recurrent fluctuations in the number of new registrations (or fluctuations in the difference from the number of new registrations for the synthetic variable). Their magnitude is much larger than the possible effect of the scrappage scheme and therefore does not allow its reliable identification.

Another reason why it is difficult to identify the impact of scrappage schemes is the way in which they were introduced. Only a few countries have introduced scrappage schemes on a one-off basis and for a short period of time. Measuring the impact of the scheme is then methodologically relatively straightforward. This is the case in Germany and Slovakia, where the results were significant. The challenge comes from countries that have implemented a series of scrappage schemes with different durations, different eligibility conditions and different levels of financial incentives. An example is France, where a scrappage scheme (under a different name) was in operation both before and after the period considered, differing essentially only in the level of the scrappage premium; moreover, even during the official scrappage scheme, the level of the scrappage premium changed several times. In the current model, we have only used a dummy variable for the whole period of the scrappage scheme in France, but other model settings are worth testing in the future. Other countries where it might be helpful to consider other scrappage schemes are Italy, Portugal, Romania and Spain.

We also paid particular attention to determining the length of the anticipation period and pull-forward period for each country. However, the significance of these periods could not be demonstrated as the respective dummy variables were not significant enough for any of the countries. At least for some countries, the coefficients have the expected (negative) sign. However, this is not the case for all countries. It turns out that the impact of scrappage schemes can only be statistically proven for some countries – significant for Germany and Slovakia, then Greece and Italy, and not significant for Austria, Luxembourg, Spain and Portugal. For the other countries, the impact of scrappage schemes could not be demonstrated. This was either because the treatment itself did not have a large effect, or because the anticipation and pull-forward periods offset any positive effects of the treatment.

The results of the quantitative analysis of the effectiveness of the car scrappage schemes can be related to the design of the schemes in each country and also to the respective budgets, as discussed in the descriptive analysis. From this point of view, the success of the Slovak car scrappage scheme can be considered to be above average. On the one hand, a net positive effect of the scrapping premium on the number of new registrations has been demonstrated and, on the other hand, the Slovak scheme was very fast (1.17% fleet renewal per month). In

addition, the Slovak budget for the car scrapping scheme was not too high (in monthly terms it was in the middle of all countries). However, it should be noted that the monthly budget per GDP was the second highest – higher than in Germany.

Germany is the second country where the impact of the car scrapping scheme was found to be most significant. The descriptive analysis shows that this was achieved at a relatively high cost. The scrapping premium was the highest of all countries (and significantly higher than in most countries), but the rate at which it succeeded in scrapping vehicles was half that of Slovakia. Cyprus, for example, managed to scrap a similar percentage of its fleet as Germany, but in Germany the scrapping premium per GDP per capita was more than twice as high. The efficiency of the resources spent on the German scrapping scheme was therefore lower than in some other countries.

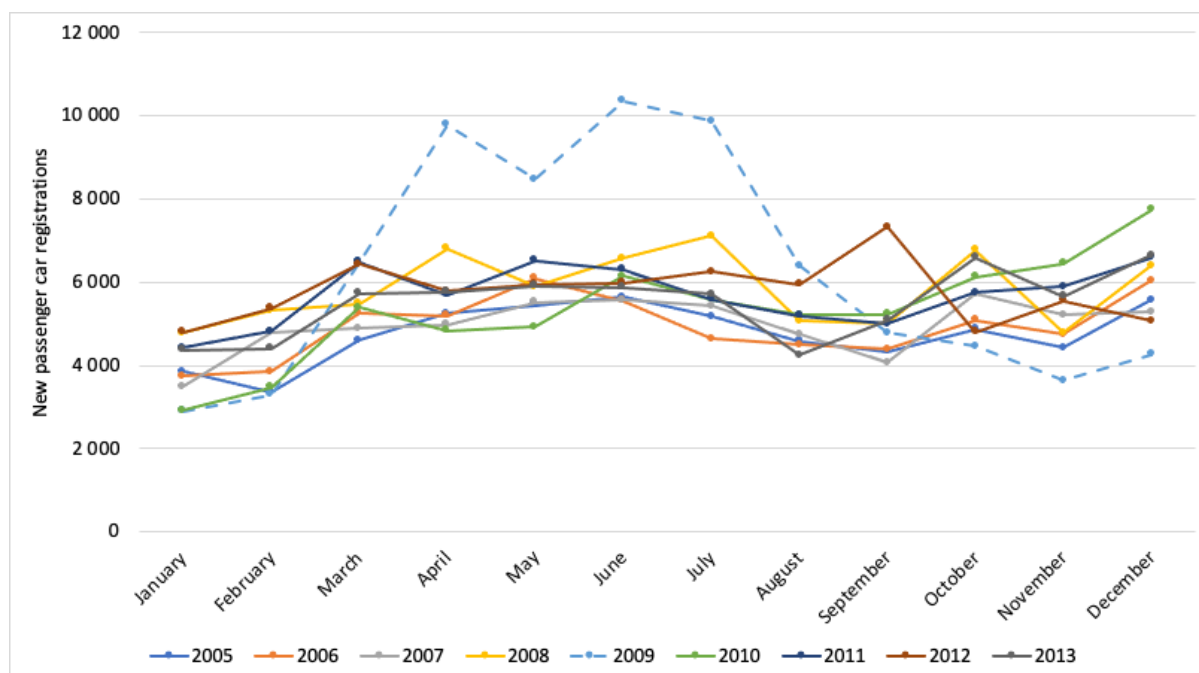
In addition, unique detailed data available for Slovakia and the Czech Republic allowed us to examine these two countries in more detail. We first checked the comparability of these two countries with the same analysis as we did with the synthetic variable. The results were comparable and statistically significant, justifying further analyses. The first of these showed that the scrapping scheme had different effects on different car brands. Brands such as Citroen, Dacia, Lada, Peugeot, Renault, Seat and Toyota benefited. On the other hand, brands such as BMW, Dodge, Ford, Honda, Mercedes and Volvo were negatively affected. This is as expected. Slovakia only offered a scrapping premium for cars costing up to €25,000. Naturally, this benefited those brands that offered such models.

Another question is whether a similar effect can be demonstrated in countries where there was no price cap on new car purchases. Indeed, there is reason to believe that even then consumers tended to prefer cheaper cars. One reason is the proportion of the car scrapping premium in the price of the car – if consumers were concerned with the percentage discount rather than the absolute amount of the discount, the scrapping premium would make cheaper models more attractive. The second reason may be the price elasticity of demand for cars, which is likely to be higher for poorer consumers.

In any case, as the figure below shows, new car registrations in Slovakia reached a record high in 2009 as a result of the scrapping scheme. The important question, however, is whether domestic car production has really been supported.



**Figure 16: New passenger car registrations in Slovakia (2005–2013)**



Source: ACEA, own creation.

As discussed in the previous section, brands such as Citroen, Dacia, Lada, Peugeot, Renault, Seat and Toyota proved to be statistically significant in Slovakia compared to Czechia in terms of new passenger car registrations. The variance in the number of new passenger car registrations from other manufacturers, like Kia Motors or Volkswagen, also producing in Slovakia during the same period, was not statistically significant. It is also relevant to mention in this context that Toyota, Peugeot and Citroën were also very important car manufacturers in Czechia during the period of 2008–2010 (see next table).

**Table 16: Car manufacturers and car models that were produced in Slovakia and Czechia during the period of 2008–2010**

Slovakia	Czechia
<b>Volkswagen:</b> Volkswagen Polo, Volkswagen Touareg, Audi Q7, Škoda Octavia	<b>Škoda Auto:</b> Škoda Fabia, Škoda Octavia, Škoda Superb
<b>PSA Peugeot Citroën:</b> Peugeot 207, Citroën C3 Picasso	<b>TPCA (Toyota Peugeot Citroën Automobile):</b> Toyota Aygo, Peugeot 107 (later rebranded as Peugeot 108), Citroën C1
<b>Kia Motors:</b> Kia Cee'd, Kia Sportage	<b>Hyundai Motor Manufacturing Czech (HMMC):</b> Hyundai i30, Hyundai ix20

Source: Own creation.

Indeed, local media also reported that while new car sales in Slovakia were at a record high during 2009, domestic production of new cars fell by a fifth compared to the previous year.

Thus, Slovakia lost its position as the European leader in per capita car production, overtaken by Czechia that benefited from the increased demand for new cars in Slovakia, but also in Germany. These findings are also in line with conclusions of Malecek & Melcher (2016), who stated that the effects of the German car scrapping scheme are estimated to have boosted real GDP growth in Czechia by between 0.4 and 0.5 percentage points in 2009. However, the fact that we had data on car brands, but not on individual models, prevented us from accurately measuring how much of the newly induced demand was met by domestic production and how much by imports (in one case, this problem even extends to the model: the Škoda Octavia happened to be produced in both Slovakia and the Czech Republic in 2008–2010).

In the future, it would be useful to add other dimensions to the analysis. First, in this analysis we have only examined one type of compensatory behaviour, namely intertemporal substitution. However, the scrapping premium may also crowd out other types of purchases: for example, consumers may have started buying new cars at the expense of used cars or reduced purchases of other goods (presumably durables). The question is therefore whether the scrapping scheme has increased total household spending. Moreover, the average age of deregistered cars in Slovakia fell by almost two years during the two months of the scrapping scheme. This raises the question of whether these cars could have been in good working order for some time, but were taken off the road for the coveted premium. There is also the question of how the total value of cars sold has changed – it is possible that the net increase in the number of cars sold has been offset by a lower average price. This hypothesis would also be supported by the development of average motor car prices in Slovakia in 2009, which, according to data from the European Central Bank, declined slightly in 2008 (around 1% per month) and then fell by more than 6% month-on-month in March 2009 (the first month of the scrapping scheme).

## **7. Conclusions and future research directions**

The aim of this paper was to examine the effectiveness of car scrapping schemes in European countries around 2009, when the economic crisis was in full swing and car sales were falling sharply. We therefore focused on the common objective of these schemes, namely to stimulate new car sales and renew the car fleet.

In assessing the effectiveness of different car scrapping schemes across the EU, this research found no clear correlation between the level of the scrapping premium and the number of cars scrapped. Even after adjusting for factors such as the size of the country, the length of the scheme and the wealth of the country, no clear patterns emerged. However, the data indicate a negative relationship between the duration of the scheme and the scrapping rate, with shorter schemes scrapping cars at a faster rate. It also shows that the size of the budget has an impact on the number of cars scrapped, although schemes with larger budgets may be less efficient.

Country-specific variations were observed within the descriptive analysis, particularly in Greece, Slovakia, Germany, Austria and Portugal. Despite possible data inconsistencies, the Greek scheme appeared to be highly effective in a certain way, probably due to the uncertain duration of the scheme related to impending changes in government. Slovakia achieved impressive results in a relatively short period of time, although its scheme was comparatively average in terms of budget allocation and fleet replacement. Germany, with the highest average scrappage premium and a scheme cost exceeding all other countries combined, was below average in terms of fleet replacement in relation to GDP expenditure. Comparisons with Cyprus, which achieved similar fleet renewal at a much lower cost, suggest that the German scheme may have been more generous than necessary. Austria outperformed Portugal in fleet renewal despite having a lower budget and a shorter duration of the scheme. This discrepancy may be attributed to Austria's time-limited innovative approach, as well as to Portugal's more conventional scheme adaptation.

Given that any scrappage scheme is a burden on public budgets and always has costs in terms of other unrealised projects (whether public or private), our analysis finds no justification for long-lasting and expensive schemes. Comparisons have shown that the effectiveness of scrappage schemes declines over time and that the level of the scrappage premium is not as important as other factors. If the political representation decides to introduce a scrappage scheme, it should be limited to a few months, with a clearly defined target in terms of eligibility for scrappage and eligibility for new cars. The money saved could be used for other projects or to reduce the tax burden.

In any case, our statistical analysis confirms that the existence of scrappage schemes appears to have a significant impact on new passenger car registrations in many countries, such as Germany and Slovakia, then Greece and Italy, and was somewhat significant for Austria, Luxembourg, Spain and Portugal. In other words, the introduction of the scrappage scheme in these countries had a positive effect on the number of new car registrations compared to countries that did not introduce the scheme.

On the other hand, in France, Ireland, the Netherlands and the United Kingdom, the impact of the scrappage scheme could not be demonstrated. The impact of the scrappage scheme was either too small or was cancelled out in the anticipation and pull-forward periods. In some cases, the specific design of the scheme may be to blame – for example, in the Netherlands it was possible to buy used cars more than eight years old. Elsewhere, however, there is no such explanation – in the UK, for example, the design of the scrappage scheme and its budget (as a percentage of GDP per capita) were similar to those in Italy. It is therefore not possible to make a general claim that a scrappage scheme will actually boost new car sales, and caution should be exercised when considering its introduction. It should also not be forgotten that the scrappage scheme may encourage people to buy cheaper cars. This further undermines the potential increase in car sales and therefore reduces the effectiveness of the scrappage scheme in this direction.

Moreover, one of the aims of the car scrappage scheme in Slovakia was to support domestic car production. At the time, Slovakia was the largest car producer in the world in terms of the

number of cars produced per capita. The crisis in the automotive industry therefore hit Slovakia hard. Our statistical analysis showed that the scrappage scheme mainly supported import brands. In this respect, the scrappage scheme did not fulfil expectations. It should be noted that many car companies have factories all over the world and produce different models in different countries. Therefore, in order to calculate in detail how much domestic and import brands have been supported, it would be necessary to obtain data broken down by model. This is a subject for further research.

Overall, our findings point to the need for careful policy design and suggest that the effectiveness of scrappage schemes is not simply a function of premium levels or budget allocations, but may be influenced by factors such as scheme duration, policy environment and innovative approaches to implementation. Scrappage is not a policy that can be clearly recommended. On the contrary, its effects have only been partially demonstrated, and if further research were to include other effects (e.g. a fall in the average price of cars, a shift in expenditure from other sectors), the effectiveness of scrapping schemes in terms of social welfare would be even lower. It should be noted that the effects were found to be particularly significant in countries that spent a high percentage of GDP per capita on car scrapping schemes. This raises serious additional doubts not only about the effectiveness but also the efficiency of such a policy measure (compared to other available policies to support economic activity).

The analysis could also extend to issues other than economic efficiency. The emission savings from scrapped cars and newly sold fuel-efficient cars have been examined in other studies. However, monthly data and our chosen methodology would allow a more precise measurement of the environmental effects. It would also be possible to ask questions about the overall environmental impact, i.e. not only focusing on emission savings, but taking into account the whole life cycle of the vehicles (the newly sold vehicles must have been produced and will have to be scrapped one day).

## **Annex 1: Brief description of the scrappage schemes in each country**

### **Austria<sup>6</sup>**

Total cost: €22.5 million (0.008 % of GDP)

Time period and eligibility:

- The scheme was designed to run from 1 April 2009 to 31 December 2009 or until the funds were exhausted, which occurred on 8 July 2009. New cars could be registered until 31 December 2009.
- Eligible old cars were passenger cars at least 13 years old. Eligible new cars had to meet the Euro 4 standard.

Incentive value:

- Under the scrappage scheme, each car was given an incentive worth €1,500. The government only contributed €750 towards the incentive, with the remaining €750 (or more) being covered by the automotive industry, including car manufacturers, national sales companies, importers, and dealers.

### **Cyprus<sup>7</sup>**

Total cost:

- €11.4 million in 2008 (0.060 % of GDP)
- €8.5 million in 2009 (0.046 % of GDP)
- €2 million in 2010 (0.010 % of GDP)

Time period and eligibility:

- Several waves of the scrappage scheme have been implemented in Cyprus.
- The first scheme was designed to run from January 2008 to July 2008 in two stages (January–March, May–July). In the first stage, eligible old cars were passenger cars at least 20 years old; in the second stage, they had to be at least 15 years old.
- The second scheme ran from February 2009 until September 2009 when the funds were exhausted. Eligible old cars were passenger cars at least 15 years old.
- The third scheme ran from July 2010 until the end of 2010. Eligible old cars were passenger cars at least 15 years old, including the last 10 years in Cyprus. Eligible new cars had to emit less than 165 g CO<sub>2</sub> per km.

Incentive value:

- The 2008 scheme included four levels of financial support: If the registered old car had paid road tax in the 12 months before scrapping and the owner bought a car with a fuel consumption of up to five litres per 100 km, the allowance was €1,708. If the

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<sup>6</sup> Source: Ökoprämiengesetz (2009), Lampert (2014).

<sup>7</sup> Source: Leonidou (2008a), Leonidou (2008b), *Ετήσια Έκθεση* (2009), Cyprus Mail (2010), Buttigieg et al. (2010a), *Σχέδιο* (2010).

new car had a consumption of up to seven litres per 100 km, the contribution was €1,281. Those who did not buy a new car had a contribution of €683. Finally, those who did not buy a new car and their registered old car did not have a valid road tax received €256.

- The 2009 scheme had the same conditions.
- In 2010, the allowance was €1,800 and was only for those who bought an eligible new car.

## France<sup>8</sup>

Total cost:

- €14 million in 2008 (0.0007 % of GDP)
- €514 million in 2009 (0.026 % of GDP)
- €501 million in 2010 (0.025 % of GDP)

Time period and eligibility:

- Several waves of the scrappage scheme have been implemented in France.
- The first scheme ran from 5 December 2007 to 3 December 2008. Eligible old cars were passenger cars older than 15 years.
- The second scheme ran from 4 December 2008 and was prolonged until 31 December 2010. Eligible old cars were passenger cars older than 10 years. Eligible new cars had to emit less than 160 g CO<sub>2</sub> per km (reduced to 155 g CO<sub>2</sub> per km from 1 January 2010). Light commercial vehicles were also eligible; they were not subject to the emission limit.
- In 2011, France returned to the original scheme (cars older than 15 years), and the emission limit was lowered to 150 g CO<sub>2</sub> per km.

Incentive value:

- At the end of 2007, environmental purchase incentives were introduced, positive for cars emitting less than 131 g CO<sub>2</sub> per km and negative for cars emitting more than 160 g CO<sub>2</sub> per km. The positive incentive started at €200 (below 131 g CO<sub>2</sub> per km) and ended at €5,000 (below 60 g CO<sub>2</sub> per km). Buyers could get an additional bonus of €300 (called a super bonus) if they scrapped an old car older than 15 years.
- A new scheme aimed specifically at scrapping old cars (prime à la casse) was in place from 4 December 2008 until the end of 2010. The amount of the allowance varied over time: €1 000 in 2009, €750 by the end of June 2010, €500 by the end of 2010.
- In 2011, France returned to the original system (super bonus of €300, decreased to €200 in 2012). The eco-bonus-malus system has been in place since then and is still evolving.

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<sup>8</sup> Sources: *La prime à la casse* (2010), *PLR2009* (2010), *PLR2010* (2011), *PLR2011* (2012), *Évaluation* (2013), *Les Comptes* (2009), *PLR2012* (2013), Michel (2014), Buttigieg et al. (2010a).

## Germany<sup>9</sup>

Total cost: €4,832 million (0.197 % of GDP)

Time period and eligibility:

- The scheme was designed to run from 14 January 2009 to 31 December 2009 or until the funds were exhausted, which occurred on 2 September 2009.
- Eligible old cars were passenger cars at least 9 years old. Eligible new cars had to meet the Euro 4 standard. Used vehicles less than one year old were also eligible.

Incentive value:

- The scrappage scheme delivered a fixed premium incentive of €2,500 per vehicle.

## Greece<sup>10</sup>

Total cost: €108 million<sup>11</sup> (0.045 % of GDP)

Time period and eligibility:

- In 2009, Greece implemented two schemes aimed at promoting new car sales.
- The first scheme ran from early April 2009 to early August 2009. It consisted of halving the registration fee for new or imported cars.
- The second scheme, a scrappage scheme, was introduced on 28 September 2009 and was to last until the end of 2012. However, the newly elected government cancelled it on 2 November 2009 with immediate effect.
- Eligible cars for scrapping were those meeting at most the Euro 3 standard. Eligible new cars were cars meeting the Euro 4 standard.

Incentive value:

- The registration fee reduction scheme applied to the first registration of all new and used cars meeting the latest Euro 4 standard. It should be noted that in Greece, the first registration fee was significantly higher than in the rest of the European Union, ranging from 5% to 50% of the factory price of the car, depending on the engine cubic capacity.
- The scrappage scheme included a triple incentive:
- 1) The scheme provided financial support for scrapping old cars. The amount of support was graduated according to the cubic capacity (from €500 for an engine up to 900 cc, up to €2,200 for an engine over 2,400 cc).
- 2) When buying a new car meeting the Euro 4 or 5 standard, aid of €1,000 was granted (€1,500 in case of a light commercial vehicle).
- 3) Road tolls were to vary according to the Euro standard of the car (from a bonus of €18 for Euro 4 or 5 cars, to a malus of €150 for Euro 0 or 1 cars).

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<sup>9</sup> Source: VDA (2013), *Abschlussbericht* (2010), Buttigieg et al. (2010a).

<sup>10</sup> Source: TO BHMA (2009b), *Μειώνεται* (2009), ΣΕΑΑ (2009), TO BHMA (2009c), TO BHMA (2009a), Buttigieg et al. (2010a)

<sup>11</sup> Rough estimate based on Buttigieg et al. (2010a).

## **Ireland<sup>12</sup>**

Total cost: €37.6 million (0.022 % of GDP)

Time period and eligibility:

- The scheme was designed to run from 1 January 2010 to 31 December 2010. In late 2010, it was decided to extend the scheme until 30 June 2011.
- Eligible old cars were passenger cars at least 10 years old, with valid insurance in the last year. Eligible new cars had to emit less than 140 g CO<sub>2</sub> per km.

Incentive value:

- The scheme provided a vehicle registration tax rebate of €1,500. In the extended period (2011), this was lowered to €1,250 but made available to a spouse or a civil partner.

## **Italy<sup>13</sup>**

Total cost: €1,284 million (0.081 % of GDP)

Time period and eligibility:

- There have been several waves of scrappage schemes in Italy, starting as early as 1997.
- Shortly before the economic crisis, a scrappage scheme was in place throughout 2007. Eligible cars for scrapping were those meeting at most the Euro 1 standard; eligible new cars were those meeting the Euro 4 standard and the emission limit of 140 g CO<sub>2</sub> per km.
- The next scheme was in place throughout 2008. Eligible cars for scrapping were those meeting at most the Euro 2 standard and more than 11 years old; eligible new cars were those meeting the Euro 4 standard and the emission limit of 140 g CO<sub>2</sub> per km (petrol), or 130 g CO<sub>2</sub> per km (diesel).
- The third scheme ran from 7 February 2009 to 31 December 2009, with new cars able to be registered until 31 March 2010. Eligible cars for scrapping were those meeting at most the Euro 2 standard and more than 9 years old. The rules for new cars remained the same as the year before.
- All waves of the scrappage scheme targeted not only passenger cars but also light commercial vehicles.

Incentive value:

- The 2007 scheme provided a scrapping premium of €800 and a two-year remission of road tax (three years if the new car had an engine up to 1,300 cc, or if it was a family of at least six and they had no other car). A bonus of €1,500 was added if the new car was gas-powered, and €2,000 for electric cars. (There was no need to scrap the old car

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<sup>12</sup> Source: 'Car Scrappage' (2009), 'Scrappage Scheme' (2010), 'End of the Road' (2011).

<sup>13</sup> Source: 'Auto' (2009), Sabelli (2007), Sabelli (2008), Sabelli (2009), Marin & Zoboli (2020), Buttigieg et al. (2010a), *Fleet Renewal* (2010), *Bilancio* (2010).



to get this bonus.) If a person did not buy a new car after scrapping an old one and committed not to buy new vehicles for three years, the state reimbursed them for a one-year season ticket to local public transport within their municipality of residence or workplace.

- The 2008 scheme reduced the aid to €700 and the road tax remission for one year (three years if the scrapped vehicle only complied with Euro 0). The original level of support (€800) was only for cars with emissions below 120 g CO<sub>2</sub> per km. The level of support for gas and electric cars remained as in 2007.
- The 2009 scheme increased the basic support to €1,500 but abolished the remission of road tax (which was around €100–200 per year). The age of eligible old cars was reduced to 9 years.
- The basic bonus for gas cars was €1,500, rising to €2,000 if the car emitted less than 120g of CO<sub>2</sub> per km. The basic bonus for electric cars was €1,500, increased to €3,000 if the car emitted 120 g CO<sub>2</sub> per km, and €3,500 if the car emitted less than 120 g CO<sub>2</sub> per km.
- In the case of light commercial vehicles, the scrapping premium was €2,500. The basic bonus for new gas light commercial vehicles was €1,500, increased to €2,000 if the car emitted less than 120 g CO<sub>2</sub> per km. The bonus for CNG-powered cars was €4,000.

## **Luxembourg<sup>14</sup>**

Total cost: €15.2 million (0.038 % of GDP)

Time period and eligibility:

- In Luxembourg, the scrappage scheme (called PRIME CAR-e plus) was introduced as an extension of an existing scheme to promote the sale of environmentally friendly cars.
- The scrappage scheme was to run from 22 January 2009 to 31 December 2009. At the end of 2009, it was decided to extend the scrappage scheme until 31 July 2010.
- Eligible old cars were passenger cars older than 10 years; associated eligible new cars had to emit less than 150 g CO<sub>2</sub> per km.
- Independently, the PRIME CAR-e scheme promoted the sale of more environmentally friendly cars. It was introduced on 5 December 2007 and designed to run until 31 December 2009. It was repeatedly extended until the end of 2012. After that, only the electric and hybrid variant was valid until 31 December 2014.
- Eligible new cars had to emit less than 120 g CO<sub>2</sub> per km which was lowered to 110 g from 1 August 2010, to 100 g from 1 August 2011. (In case of households with at least six members and their large car, or in case of cars for disabled people, electric, gas or hybrid cars, the threshold was 160 g CO<sub>2</sub> per km throughout the validity of the scheme.)

Incentive value:

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<sup>14</sup> Source: *Ministère* (2010), *Prime* (2013).

- The scrappage premium for eligible new cars was €1,500, rising to €2,500 if the car emitted up to 120g of CO<sub>2</sub> per km (160g for large households and their large cars, cars for disabled people, electric, gas or hybrid cars), and to €3,250 if the car emitted less up to 100g of CO<sub>2</sub> per km.
- The premium that was available to those who bought a new car without scrapping the old one, was €750 for eligible new cars. From 1 August 2010, it was raised to €1500 for cars with emissions up to 100 g CO<sub>2</sub> per km (90 g CO<sub>2</sub> per km from 1 August 2011).
- From 1 August 2011, a €3,000 bonus was introduced for electric cars and cars with emissions of up to 60 g CO<sub>2</sub> per km which was raised to €5,000 from 1 January 2012.

## Netherlands<sup>15</sup>

Total cost: €82.4 million (0,013 % of GDP)

Time period and eligibility:

- The scheme was designed to run from 29 May 2009 to 31 December 2010 or until the funds were exhausted, which occurred on 21 April 2010.
- Eligible old cars were passenger cars and light commercial vehicles more than 9 years old (13 years in case of a petrol engine). The cars had to have a valid period motor vehicle test at least three months old. Eligible cars purchased were petrol-engined cars built from 2001 or diesel-engined cars with a diesel particulate filter; the car had to comply with Euro 4 or have particulate emissions of up to 5 mg per kilometre.

Incentive value:

- The amount of financial support depended on the age and type of scrapped car. For cars and vans with a petrol engine that were registered for the first time up to 1989, the premium was €750; for the first registration between 1990 and 1995, the premium was €1,000. For diesel cars and vans registered up to 1999, the premium was €1,000; only for vans weighing over 1,800 kg (but under 3,500 kg) the premium was €1,750.
- Beyond the national scheme, two cities came up with their own scheme. The Hague gave car owners an additional bonus of €500. If someone did not buy a new car after scrapping an old car (which disqualified them from the national scheme), they received a bonus of €1 000. Amsterdam has had a similar system since 1 October 2009, where, depending on the characteristics of the old car, people received between €250 and €1,000 on top of the national scrapping premium, or between €500 and €1,000 if they did not buy a new car.

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<sup>15</sup> Source: *Evaluatie* (2010), *De Nationale Sloopregeling* (2011).

## Portugal<sup>16</sup>

Total cost: €59 million<sup>17</sup> (0,034 % of GDP)

Time period and eligibility:

- Portugal introduced a scrappage scheme as early as 1 December 2000. Eligible vehicles for scrapping were those at least 10 years old, both passenger cars and light commercial vehicles. No restrictions were initially placed on new cars. It was not until 2009 that an emission limit for new cars was introduced (140 g CO<sub>2</sub> per km, followed by 130 g CO<sub>2</sub> per km in 2010).
- Following the economic crisis, the scheme was temporarily extended from 7 August 2009 to 31 December 2009. The required age of the old vehicle was reduced to 8 years and the financial incentive was increased. The scheme was to continue in a reduced form in 2010, but due to the delayed approval of the state budget, it did not apply until 29 April 2010. It finally ended on 31 December 2010.
- However, Portugal continued to support scrapping under a different scheme. Since July 2010, a €5,000 premium has been introduced for the purchase of an electric car, increased by €1,500 in the case of scrapping an internal combustion engine vehicle that is at least 10 years old.

Incentive value:

- Since 2000, the financial incentive has taken the form of a car tax rebate for the purchase of a new car, amounting to 150,000 escudos (€750) for cars at least 10 years old and 200,000 escudos (€1,000) for cars at least 15 years old. In 2004, the premium was consolidated at a higher amount (€1,000). In 2006, the premium for older cars was raised to €1,250.
- A temporary extension of the scheme in 2009 meant a premium of €1,250 if the old vehicle was at least 8 years old, or €1,500 if it was at least 13 years old. When it ended, the age limits in 2010 reverted to the original values of 10 years and 15 years, respectively, and the premiums were reduced to €750 and €1,000, respectively. At the same time, the emission limit for new cars was lowered to 130 g of CO<sub>2</sub> per km.

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<sup>16</sup> Source: Decreto-Lei (2000), Lei (2003), Decreto-Lei (2006), Lei (2008), Lei (2009), Portaria (2010), *Valorcar* (2010), *Valorcar* (2011).

<sup>17</sup> Own estimate based on the number of vehicles scrapped under the scrappage scheme Programa de Incentivo Fiscal ao Abate de VFV (PIFAVFV) and the likely age distribution of scrapped vehicles. Data for the estimation obtained from *Valorcar* (2010). Official figures are not available.

## Romania<sup>18</sup>

### Total cost:

- €12.0 million in 2005 (0.015 % of GDP)
- €13.3 million in 2006 (0.013 % of GDP)
- €14.0 million in 2007 (0.012 % of GDP)
- €23.3 million in 2008 (0.017 % of GDP)
- €29.1 million in 2009 (0.023 % of GDP)
- €141.5 million in 2010 (0.112 % of GDP)
- €101.9 million in 2011 (0.075 % of GDP)
- €34.3 million in 2012 (0.025 % of GDP)
- €21.2 million in 2013 (0.015 % of GDP)

### Time period and eligibility:

- In Romania, the scrappage scheme has been in force in various forms since 2005. The scrappage scheme was approved on 26 November 2004, initiated on 1 May 2005 and has been extended every year. Initially, cars at least 12 years old were eligible for scrapping. There was no emission restriction on new cars. Since 2009, the required age of a scrapped car has been reduced to 10 years. Since June 2009, light commercial vehicles have also been eligible. From 2010, legal entities could also benefit from the scrappage scheme (under the *de minimis* regime). In 2010–2011, the scheme also applied to tractors. During 2011, hybrid and electric vehicles were included in the scheme. In 2012, the required age of an old vehicle for legal entities was reduced to five years.
- In subsequent years, the scheme has been further modified. Currently (2023), cars that are at least 6 years old are eligible for scrapping.

### Incentive value:

- From 2005 to 2008 the scrapping premium was RON 3,000 (about €850). In 2009 it was increased to RON 3,800 (about €900). Since 2010, the same person who scrapped the old car did not have to buy a new car. The buyer of a new car (if an individual) could use up to three scrapping vouchers (the vouchers were valid for 30 days), which made the system much more flexible.
- In 2013, the conditions of the financial incentive were changed again: the amount of the scrapping voucher was RON 6,500 (about €1,460), plus an ecobonus of RON 500 (about €110) for each of the following characteristics of a new vehicle (maximum two

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<sup>18</sup> Source: Ordonanță (2004), Ordonanță (2006), Ordonanță (2007), Ordonanță (2008a), Ordonanță (2008b), *Ghid de Finanțare* (2009), *Ghid de Finanțare* (2013), *Ghid de Finanțare* (2020), Răceanu (2014), *Raportul* (2006), *Raportul* (2007), *Comunicat de Presă* (2007a), *Comunicat de Presă* (2007b), *Raportul* (2008), *Comunicat de Presă* (2008a), *Comunicat de Presă* (2008b), *Raportul* (2009), *Comunicat de Presă* (2009a), *Comunicat de Presă* (2009b), *Raportul* (2010), *Direcția de Comunicare* (2010), *Raportul* (2011), *Comunicat de Presă* (2011a), *Comunicat de Presă* (2011b), *Raportul* (2012), *Comunicat de Presă* (2012), *Raportul* (2013), *Comunicat de Presă* (2013a), *Comunicat de Presă* (2013b), *Raportul* (2014), *Evoluția* (2022).

ecobonuses together): meeting the Euro 6 standard, emissions of less than 100 g CO<sub>2</sub> per km, hybrid drive. The scrapping voucher ceased to be transferable; its validity for set to 45 days.

- In subsequent years, the incentives were further modified. At present (2023), the scrapping bonus (the so-called Rabla Classic Programme) for the purchase of a new vehicle (or motorcycle) is RON 7,000 (€1,400) for the scrapping of one vehicle, or RON 10,000 (€2,000) for the scrapping of two vehicles. In addition, an ecobonus of RON 1,500 (€300) can be obtained if the new vehicle has emissions of no more than 120 g CO<sub>2</sub> per km or burns LPG/CNG or an ecobonus of RON 3,000 (€600) if the new vehicle is equipped with a hybrid engine. If the scrapped vehicle was at least 15 years old and complied with the Euro 3 standard at most, an ecobonus of RON 1,500 (€300) is granted. In addition, there is the so-called Rabla Plus programme, where the scrapping bonus is RON 51,000 (€10,200) for the purchase of a new pure electric vehicle or a new vehicle with a hydrogen fuel cell, excluding motorcycles (RON 54,000 (€10,800) if two cars are scrapped); RON 26,000 (€11,200) for the purchase of a new hybrid electric vehicle, excluding motorcycles, which produces no more than 80 g CO<sub>2</sub> per km (RON 29,000 (€5,800) if two cars are scrapped); RON 26,000 (€5,200) for the purchase of an electric motorcycle. If the scrapped vehicle was at least 15 years old and complies with Euro 3 at most, an ecobonus of RON 1,500 (€300) is granted.

## **Slovakia<sup>19</sup>**

Total cost: €49.8 million (0.078 % of GDP)

Time period and eligibility:

- The scrapping scheme was to run from 9 March 2009 to 31 December 2009 or until the number of scrapped vehicles reached 22,100. This occurred on 25 March 2009. A new scheme was therefore launched on 9 April 2009 with the same limit on the number of scrapped vehicles. The scheme was already exhausted on 14 April 2009. Eligible vehicles for scrapping were those older than 10 years. Eligible new cars were cars registered for a maximum of 6 months or with a maximum mileage of 6,000 km, and with the price not exceeding €25,000. The scheme was open both to individuals and legal entities.

Incentive value:

- In the first wave of the scrapping scheme, the scrapping premium was €1,000. If the dealer gave a €500 discount, the premium increased to €1,500. In the second wave of the scrapping scheme, one premium of €1,000 was granted, but only if the dealer provided a discount of the same amount.

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<sup>19</sup> Source: Výnos (2009a), Výnos (2009b), *Informácia o Priebehu Čerpania* (2009), *Informácia o Priebehu Čerpania* (2010).

## Spain<sup>20</sup>

Total cost:

- Plan VIVE: €145.6 million<sup>21</sup> (0.014 % of GDP)
- Plan 2000e: €461.8 million<sup>22</sup> (0.043 % of GDP)
- Plan PIVE1–4: €365 million (0.036 % of GDP)

Time period and eligibility:

- Spain has a long history of various scrappage schemes. Between 1994 and 1997, the *Renove Plan* ran, providing a discount on registration tax if a vehicle at least seven years old was scrapped. Between 1997 and 2007, the *Prever Plan* ran. This provided a registration tax rebate for scrapping a vehicle that was at least 10 years old. In 2001–2003, the scheme was extended to provide a higher incentive if the scrapped vehicle was a leaded petrol vehicle and the newly purchased vehicle was an unleaded petrol vehicle. It was also possible to buy a used car up to five years old or a light commercial vehicle. Between 2004 and 2006, the *Nuevo Prever Plan* ran, combining the previous plans into one. This plan was eventually extended until the end of 2007; in the last year, however, the scheme was limited to new passenger cars.
- On 27 June 2008, the Council of Ministers approved the so-called *VIVE Plan* (*Vehículo Innovador-Vehículo Ecológico*), which was to run from August 2008 to July 2010. Cars older than 15 years were eligible for scrapping. To be eligible, a new vehicle had to either have emissions of up to 120 g CO<sub>2</sub> per km or have emissions of up to 140 g CO<sub>2</sub> per km while being equipped with an electronic stabilisation system and occupancy detectors in the front seats. However, the setting of financial incentives attracted little interest (after 100 days of validity, only 50 incentives had been used) and the government therefore modified the conditions in November 2008. Cars that were at least 10 years old or with at least 250,000 km on the clock became eligible; used cars up to five years old could also be purchased, as well as light commercial vehicles. The financial incentives have also changed significantly (see on the right). This accelerated the uptake of the scheme and the 2008–2009 budget was exhausted at the end of May 2009.
- For this reason, a new scheme, *Plan 2000e*, was introduced on 23 May 2009, which was to run from 18 May 2009 (retrospectively) until 18 May 2010 or until the budget (200,000 vehicles) was exhausted. By November 2009, the budget was almost

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<sup>20</sup> Source: *El Plan Prever termina* (2007), *Referencia* (2008), *Seijo* (2008), *Costas* (2008a), *Costas* (2008b), *Real Decreto* (2009a), *Costas* (2009), *Real Decreto* (2009b), *Resolución* (2010), *Últimos Coletazos Del Plan 2000E* (2010), *El Confidencial* (2010), *Remo* (2012), *Delco* (2012), *Resolución* (2012), *Costas* (2012), *Costas* (2013a), *Resolución* (2013b), *Costas* (2013b), *Resolución* (2013a), *Real Decreto* (2013), *Consejo de Ministros* (2013), *Real Decreto* (2014a), *Autocasión* (2014), *Real Decreto* (2014b), *Real Decreto* (2014c), *Instituto para la Diversificación y el Ahorro de la Energía* (2015), *Real Decreto* (2015a), *Real Decreto* (2015b), *Estos son los ocho planes* (2020).

<sup>21</sup> The total budget was €700 million, but the disbursement was not in the form of a premium but in the form of an interest-free loan. The Council of Ministers estimated the value of the savings to the consumer at around 21% of the loan granted. To ensure comparability, we present the recalculated budget.

<sup>22</sup> Half was provided by the Spanish State, half by regional governments.

exhausted and was therefore increased by a further 80,000 vehicles. The 2010 budget was 200,000 vehicles and was exhausted in June 2010. Eligible old cars were cars that were at least 10 years old or with at least 250,000 km on the clock, or cars that were at least 12 years old (if bought second-hand and up to 5 years old at the time of purchase). Eligible new cars were cars costing up to €30,000, even if used, and up to 5 years old. The vehicle had to either have emissions of up to 120 g CO<sub>2</sub> per km, or have emissions of up to 149 g CO<sub>2</sub> per km while being equipped with an electronic stabilisation system and front seat occupancy detectors, or have emissions of up to 149 g CO<sub>2</sub> per km while being equipped with a three-way catalytic converter for petrol vehicles or an exhaust gas recirculation (EGR) device for diesel vehicles. Light commercial vehicles were also eligible; they had to meet an emission limit of 160 g CO<sub>2</sub> per km.

- The next plan came in 2012 (Plan PIVE – Programa de Incentivos al Vehículo Eficiente) and the first phase was to last from 1 October 2012 to 31 March 2013; the budget was exhausted on 11 January 2013. Eligible vehicles for scrapping were passenger cars at least 10 years old or light commercial vehicles at least 12 years old. The new vehicle had to fall into category A or B according to the Spanish Institute for Diversification and Energy Saving (Instituto para la Diversificación y Ahorro Energético). The government has gradually decided to extend the scheme as the budget has been exhausted each time: in addition, PIVE 2 (February–July 2013) introduced support for multi-family families that purchased a car with more than five seats. This could be in category C and with a price of up to €30,000. The scrapping age for light commercial vehicles was reduced to 7 years. PIVE 3 (July–October 2013) had the same conditions. PIVE 4 (October–December 2013) extended the scheme to support disabled drivers. This was followed by PIVE 5 (February–June 2014), PIVE 6 (June–October 2014, extended November–December 2014), PIVE 7 (March–April 2015, tightened the conditions where the applicant had to own the scrapped vehicle for at least one year and have a valid roadworthiness test), and PIVE 8 (May 2015–July 2016).
- The Renove plan offered a financial incentive of €480; if the vehicle was at least 10 years old, the incentive increased to €601. The Prever plan offered a financial incentive of €480 for scrapped vehicles that were at least 10 years old; if they were leaded petrol vehicles, the incentive was €721. The incentive was €480 for used cars purchased and for light commercial vehicles. In the last year of operation (2007), the incentive was limited to new passenger cars and amounted to only €480.
- Under the VIVE plan, a financial incentive was provided in the form of a low-interest loan for the purchase of a new car. The first €5,000 was granted interest-free and the rest of the purchase price (up to €20,000) at EURIBOR plus 250 basis points. The savings from the interest-free loan were estimated by the Government at €1,040. After the unsuccessful start of the scheme, the interest-free loan limit was increased to €10,000 and the maximum price of the car to €30,000 in November 2008. It was also no longer necessary to finance the entire purchase price with a loan, but only a part of it at the buyer's discretion.

- The financial support under the 2000e Plan from the State was €500; local authorities could add to this (typically €500). The seller (in the case of a new car) had to provide a €1,000 discount. In total, therefore, the support could amount to up to €2,000.
- In the PIVE plan, the state support was €1,000, to which the manufacturer had to add another €1,000. The price of a new car had to be up to €25,000. In the second phase, support for large families was added; the state incentive was €1,500. The third phase contained identical incentives. The fourth phase added support for the purchase of vehicles for the disabled (€1,500). The last, eighth phase, reduced the support to €750.

### **United Kingdom<sup>23</sup>**

Total cost: €436 million (0.028 % of GDP)

Time period and eligibility:

- The scrappage scheme was due to run from 18 May 2009 until the end of February 2010; it was subsequently extended until the end of March 2010. Vehicles eligible for scrapping were those older than 10 years, both passenger cars and light commercial vehicles. There was no restriction on new cars (the scheme applied to both passenger cars and light commercial vehicles).

Incentive value:

- The amount of the incentive was £1,000 (about €1,110); however, it had to be matched by a dealer discount of the same amount.

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<sup>23</sup> Source: HM Treasury (2009), *Car Scrappage* (2010), *Car Scrappage* (2014).



## Annex 2: Reply from the Hungarian Central Statistical Office



Dissemination Directorate  
User Relations Department  
Complex Services Section

Reference No: KSH/ADKI/18/2023  
Case number: 20230102-112111  
Contact person: Balázs KUROLI  
Subject: Quotation

Budapest, 10 February 2023

**Dr. Fanta Michael**  
Jan Evangelista Purkyně University

Dear **Dr. Fanta Michael**,

Referring to your inquiry of 02 January 2023 asking about the availability on data of the first registered passenger cars and passenger car fleet in Hungary from 2005, we would be able to provide the requested data from 2005 till 2021 with the following specification:

The data will be compiled according to the structure of the

**Template\_Michael Fanta\_Passenger car fleet.xlsx**

**Template\_Michael Fanta\_First registered passenger cars.xlsx**

files (attached on 08 February 2023 on the „Contact us” interface), altogether in  $2 \times 17 = 34$  files.

**Service fee is EUR 1 360 + VAT, i.e. one thousand three hundred and sixty Euros + Value Added Tax**

Delivery time: within 15 working days after signing the contract by both participants, but earliest on 01 March 2023. The data will be sent in CSV or TXT file format.

Should you wish to order these data, please confirm that you are ready to bear the costs of the data supply, **indicating at the same time** your company's name; its exact postal address and the address for invoicing (if it's different); the VAT (EU-tax) number for contracting and invoicing purposes. (In the absence of the VAT (EU-tax) number we shall add 27% VAT to the net sum.) Please let us know the name of the Contract signatory person and his/her position in the company, and the name/e-mail address of the contact person regarding the Contract.

The data file shall not be used for commercial or business purposes and shall not be transferred to unauthorized third party.

Annex no. 7 of HCSO Directive 19/2013 regarding cost calculation rules and rates regulate charges and their rates.

HCSO will perform the data supply in accordance with Act Nr. CLV of 2016 on official statistics, and Regulation (EU) 2016/679 of the European Parliament and the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) and Act Nr. CXII of 2011 on the right of informational self-determination and freedom of information („Privacy Act”).

Yours sincerely,

Mátyás-  
Bodovics  
Edina

Digitálisan aláírta:  
Mátyás-Bodovics Edina  
Dátum: 2023.02.10  
15:37:30 +01'00'

Head of Section

Attached documents:

**Template\_Michael Fanta\_Passenger car fleet.xlsx** and

**Template\_Michael Fanta\_First registered passenger cars.xlsx** files

(attached on the „Contact us” interface)



H-1024 Budapest, Keleti Károly utca 5–7. Postal address: 1525 Budapest, Pf. 51. Phone: +361 3456789  
E-mail: [kapcsolat@ksh.hu](mailto:kapcsolat@ksh.hu), Website: [www.ksh.hu](http://www.ksh.hu)

### Annex 3: Country weights for the construction of the synthetic variable

	Belgium	Czechia	Denmark	Estonia	Finland	Hungary	Latvia	Lithuania	Poland	Slovenia	Sweden	Iceland	Norway	Switzerland
<b>Austria</b>	0.226	0.163	0.202	0.004	0.000	0.003	0.001	0.003	0.025	0.005	0.003	0.003	0.009	0.354
<b>France</b>	0.248	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.412	0.001	0.009	0.001	0.002	0.320
<b>Germany</b>	0.023	0.021	0.024	0.016	0.016	0.017	0.010	0.016	0.025	0.018	0.135	0.017	0.025	0.639
<b>Greece</b>	0.000	0.000	0.000	0.000	0.885	0.000	0.000	0.000	0.000	0.000	0.115	0.000	0.000	0.000
<b>Ireland</b>	0.514	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.486	0.000	0.000
<b>Italy</b>	0.000	0.000	0.000	0.000	0.474	0.000	0.000	0.000	0.032	0.232	0.262	0.000	0.000	0.000
<b>Luxembourg</b>	0.000	0.000	0.000	0.000	0.273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.727	0.000
<b>Netherlands</b>	0.000	0.000	0.000	0.000	0.747	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.252
<b>Portugal</b>	0.000	0.000	0.000	0.000	0.306	0.000	0.000	0.000	0.385	0.000	0.309	0.000	0.000	0.000
<b>Slovakia</b>	0.000	0.633	0.000	0.000	0.000	0.000	0.000	0.034	0.333	0.000	0.000	0.000	0.000	0.000
<b>Spain</b>	0.000	0.000	0.000	0.000	0.538	0.000	0.231	0.000	0.131	0.000	0.100	0.000	0.000	0.000

## Annex 4: Results of difference-in-differences analysis

	<b>Intercept</b> (SD) (t-value)	<b>Pre-Policy</b> (SD) (t-value)	<b>Policy</b> (SD) (t-value)	<b>Post-Policy</b> (SD) (t-value)	<b>Country Variable</b> (SD) (t-value)	<b>DID1</b> Pre-Policy (SD) (t-value)	<b>DID2</b> Policy (SD) (t-value)	<b>DID3</b> Post-Policy (SD) (t-value)	<b>R2</b>	<b>Adj-R2</b>
<b>Alfa Romeo</b>	<b>18.15</b> 1.86 9.75***	<b>-12.154</b> 9.67 -1.26	<b>1.275</b> 4.042 0.315	<b>1.846</b> 6.966 0.265	<b>-7.269</b> 2.633 -2.761**	<b>7.269</b> 13.680 0.531	<b>5.984</b> 5.716 1.047	<b>-4.231</b> 9.851 -0.429	0.1724	0.0819
<b>Audi</b>	<b>224.08</b> 11.84 18.922***	<b>-63.08</b> 61.53 -1.025	<b>36.07</b> 25.71 1.403	<b>26.42</b> 44.31 0.596	<b>-124.65</b> 16.75 -7.443***	<b>19.65</b> 87.02 0.226	<b>-66.63</b> 36.36 -1.832	<b>-62.85</b> 62.66 -1.003	0.6174	0.5755
<b>BMW</b>	<b>195.50</b> 14.39 13.59***	<b>-118.50</b> 74.76 -1.59	<b>19.21</b> 31.24 0.62	<b>102.50</b> 53.83 1.90	<b>-81.08</b> 20.35 -3.99***	<b>30.08</b> 105.72 0.28	<b>-88.92</b> 44.18 -2.01*	<b>-108.42</b> 76.13 -1.42	0.4317	0.3695
<b>Citroen*</b>	<b>542.65</b> 25.75 21.08***	<b>-169.65</b> 133.80 -1.27	<b>109.491</b> 55.91 1.96	<b>173.35</b> 96.34 1.80	<b>-234.92</b> 36.41 -6.45***	<b>-0.08</b> 189.22 0.00	<b>139.355</b> 79.07 1.76	<b>-258.08</b> 136.25 -1.89	0.5693	0.5222
<b>Dacia</b>	<b>232.54</b> 19.07 12.19***	<b>-68.54</b> 99.10 -0.69	<b>-47.82</b> 41.41 -1.16	<b>-25.04</b> 71.36 -0.35	<b>-120.50</b> 26.97 -4.47***	<b>68.50</b> 140.15 0.49	<b>193.50</b> 58.56 3.30***	<b>18.00</b> 100.92 0.178	0.2939	0.2167
<b>Dodge</b>	<b>6.19</b> 0.60 10.41***	<b>-2.19</b> 3.09 -0.71	<b>2.95</b> 1.29 2.28*	<b>-1.69</b> 2.23 -0.76	<b>-1.96</b> 0.84 -2.33*	<b>1.96</b> 4.37 0.45	<b>-4.32</b> 1.83 -2.37*	<b>0.96</b> 3.15 0.31	0.2596	0.1786
<b>Ferrari</b>	<b>3.31</b> 0.42 7.86***	<b>-1.31</b> 2.19 -0.60	<b>0.98</b> 0.91 1.07	<b>-0.31</b> 1.58 -0.20	<b>-3.31</b> 0.60 -5.56***	<b>1.31</b> 3.09 0.42	<b>-0.98</b> 1.29 -0.76	<b>0.31</b> 2.23 0.14	0.4289	0.3664
<b>Fiat</b>	<b>342.01</b> 17.75 19.27***	<b>-29.00</b> 92.22 -0.31	<b>28.57</b> 38.53 0.74	<b>43.00</b> 66.41 0.65	<b>-139.04</b> 25.10 -5.54***	<b>-38.96</b> 130.42 -0.30	<b>155.18</b> 54.50 2.85**	<b>-81.46</b> 93.91 -0.87	0.4631	0.4043
<b>Ford</b>	<b>1048.38</b> 48.29 21.71***	<b>-104.38</b> 250.95 -0.42	<b>439.19</b> 104.86 4.19***	<b>236.62</b> 180.70 1.31	<b>-774.27</b> 68.30 -11.34***	<b>91.27</b> 354.89 0.26	<b>-414.16</b> 148.29 -2.79**	<b>-339.73</b> 255.55 -1.33	0.7926	0.7699
<b>Honda*</b>	<b>195.31</b> 9.39 20.81***	<b>-32.31</b> 48.77 -0.66	<b>28.98</b> 20.38 1.42	<b>36.19</b> 35.12 1.03	<b>-111.81</b> 13.27 -8.42***	<b>-0.19</b> 68.97 -0.01	<b>-48.91</b> 28.82 -1.70	<b>-49.69</b> 49.66 -1.01	0.6628	0.626
<b>Hyundai</b>	<b>715.39</b> 31.81 22.49***	<b>-217.39</b> 165.29 -1.32	<b>63.19</b> 69.07 0.92	<b>-48.89</b> 119.02 -0.41	<b>-490.08</b> 44.99 -10.89***	<b>136.08</b> 233.75 0.58	<b>137.51</b> 97.68 1.41	<b>-7.92</b> 168.32 -0.05	0.711	0.6794
<b>Chevrolet</b>	<b>275.96</b> 14.46 19.08***	<b>-22.96</b> 75.14 -0.31	<b>128.32</b> 31.40 4.09***	<b>35.54</b> 54.11 0.66	<b>-154.38</b> 20.45 -7.55***	<b>0.38</b> 106.26 0.01	<b>-16.90</b> 44.40 -0.38	<b>-83.12</b> 76.52 -1.09	0.6503	0.6121
<b>Chrysler</b>	<b>8.92</b> 0.60 14.87***	<b>-0.92</b> 3.12 -0.30	<b>-0.64</b> 1.30 -0.49	<b>-2.92</b> 2.25 -1.30	<b>-6.38</b> 0.85 -7.52***	<b>1.38</b> 4.41 0.31	<b>0.38</b> 1.84 0.21	<b>3.38</b> 3.18 1.07	0.5332	0.4822
<b>Iveco</b>	<b>0.27</b> 0.07 3.61***	<b>-0.27</b> 0.39 -0.70	<b>0.02</b> 0.16 0.10	<b>-0.27</b> 0.28 -0.97	<b>-0.19</b> 0.11 -1.82	<b>0.19</b> 0.55 0.35	<b>0.05</b> 0.23 0.22	<b>0.19</b> 0.39 0.49	0.0753	-0.0259
<b>Jaguar</b>	<b>8.65</b> 0.85 10.15***	<b>2.35</b> 4.43 0.53	<b>0.63</b> 1.85 0.34	<b>-2.65</b> 3.19 -0.83	<b>-4.69</b> 1.21 -3.89***	<b>-5.31</b> 6.27 -0.85	<b>0.26</b> 2.62 0.10	<b>1.19</b> 4.51 0.26	0.2678	0.1877
<b>Jeep</b>	<b>12.04</b> 0.84 14.30***	<b>-7.04</b> 4.38 -1.61	<b>1.10</b> 1.83 0.60	<b>15.46</b> 3.15 4.91***	<b>-6.96</b> 1.19 -5.85***	<b>2.96</b> 6.19 0.48	<b>-2.90</b> 2.59 -1.12	<b>-17.04</b> 4.46 -3.82***	0.6051	0.5619

	<b>Intercept</b> (SD) (t-value)	<b>Pre-Policy</b> (SD) (t-value)	<b>Policy</b> (SD) (t-value)	<b>Post-Policy</b> (SD) (t-value)	<b>Country Variable</b> (SD) (t-value)	<b>DID1</b> Pre-Policy (SD) (t-value)	<b>DID2</b> Policy (SD) (t-value)	<b>DID3</b> Post-Policy (SD) (t-value)	<b>R2</b>	<b>Adj-R2</b>
<b>Kia</b>	<b>550.42</b> 35.67 15.43***	<b>-154.42</b> 185.37 -0.83	<b>197.15</b> 77.46 2.55*	<b>-110.42</b> 133.48 -0.83	<b>-218.08</b> 50.45 -4.32***	<b>-46.92</b> 262.15 -0.18	<b>147.93</b> 109.54 1.35	<b>-13.42</b> 188.77 -0.07	0.4523	0.3924
<b>Lada</b>	<b>12.38</b> 1.95 6.35***	<b>-1.38</b> 10.13 -0.14	<b>3.19</b> 4.23 0.75	<b>-1.38</b> 7.29 -0.19	<b>0.31</b> 2.76 0.11	<b>-3.31</b> 14.33 -0.23	<b>36.2637</b> 5.99 6.06***	<b>-1.31</b> 10.32 -0.13	0.6117	0.5693
<b>Lancia</b>	<b>3.46</b> 0.42 8.16***	<b>2.54</b> 2.20 1.15	<b>2.40</b> 0.92 2.60*	<b>-0.46</b> 1.59 -0.29	<b>-0.15</b> 0.60 -0.26	<b>-2.84</b> 3.12 -0.91	<b>0.73</b> 1.30 0.56	<b>2.65</b> 2.24 1.18	0.2448	0.1622
<b>Mazda</b>	<b>178.92</b> 8.47 21.13***	<b>3.08</b> 44.01 0.07	<b>-0.07</b> 18.39 -0.01	<b>-20.42</b> 31.69 -0.65	<b>-101.38</b> 11.98 -8.47***	<b>-44.62</b> 62.23 -0.72	<b>-34.90</b> 26.01 -1.34	<b>-29.12</b> 44.81 -0.65	0.662	0.625
<b>Mercedes</b>	<b>198.77</b> 11.50 17.28***	<b>-129.77</b> 59.77 -2.17*	<b>42.37</b> 24.97 1.70	<b>79.73</b> 43.04 1.85	<b>-77.69</b> 16.27 -4.78***	<b>74.69</b> 84.52 0.88	<b>-85.02</b> 35.32 -2.41*	<b>-140.81</b> 60.86 -2.31*	0.5174	0.4646
<b>Mini</b>	<b>7.73</b> 0.87 8.85***	<b>-1.73</b> 4.54 -0.38	<b>-1.30</b> 1.90 -0.69	<b>0.27</b> 3.27 0.08	<b>-2.81</b> 1.24 -2.27*	<b>-3.19</b> 6.42 -0.50	<b>-0.76</b> 2.68 -0.29	<b>-2.69</b> 4.62 -0.58	0.1619	0.0702
<b>Mitsubishi</b>	<b>99.89</b> 5.16 19.35***	<b>-31.89</b> 26.82 -1.19	<b>16.40</b> 11.21 1.46	<b>2.12</b> 19.31 0.11	<b>-52.50</b> 7.30 -7.19***	<b>-0.50</b> 37.92 -0.01	<b>18.36</b> 15.85 -1.16	<b>-32.00</b> 27.31 -1.17	0.5964	0.5523
<b>Nissan</b>	<b>151.89</b> 7.01 21.68***	<b>-41.89</b> 36.40 -1.15	<b>-3.17</b> 15.21 -0.21	<b>77.62</b> 26.21 2.96**	<b>-41.08</b> 9.91 -4.15***	<b>15.08</b> 51.48 0.29	<b>-28.92</b> 21.51 -1.35	<b>-95.42</b> 37.07 -2.57*	0.4536	0.3939
<b>Opel</b>	<b>310.96</b> 14.32 21.72***	<b>-125.96</b> 74.38 -1.69	<b>60.04</b> 31.08 1.93	<b>-69.46</b> 53.56 -1.30	<b>-94.69</b> 20.25 -4.68***	<b>-23.31</b> 105.19 -0.22	<b>-7.59</b> 43.96 -0.17	<b>-36.31</b> 75.75 -0.48	0.4594	0.4003
<b>Peugeot</b>	<b>579.92</b> 26.46 21.92***	<b>-90.92</b> 137.49 -0.66	<b>10.22</b> 57.45 0.18	<b>-4.92</b> 99.00 -0.05	<b>-239.19</b> 37.42 -6.39***	<b>-10.81</b> 194.43 -0.06	<b>293.05</b> 81.25 3.61***	<b>-112.31</b> 140.01 -0.80	0.5163	0.4634
<b>Renault</b>	<b>867.08</b> 43.59 19.89***	<b>-298.08</b> 226.49 -1.32	<b>95.07</b> 94.64 1.01	<b>73.92</b> 163.09 0.45	<b>-514.08</b> 61.64 -8.34***	<b>303.08</b> 320.30 0.95	<b>559.22</b> 133.84 4.18***	<b>14.58</b> 230.64 0.06	0.6291	0.5885
<b>Saab</b>	<b>4.92</b> 0.679 7.25***	<b>-3.92</b> 3.53 -1.11	<b>-0.21</b> 1.47 -0.14	<b>-0.42</b> 2.54 -0.17	<b>-0.92</b> 0.96 -0.96	<b>4.92</b> 4.99 0.99	<b>-0.36</b> 2.09 -0.17	<b>0.42</b> 3.59 0.12	0.0382	-0.0669
<b>Seat</b>	<b>208.31</b> 10.91 19.09***	<b>-35.31</b> 56.70 -0.62	<b>-1.17</b> 23.69 -0.05	<b>-55.31</b> 40.83 -1.36	<b>-64.73</b> 15.43 -4.20***	<b>-38.26</b> 80.19 -0.48	<b>71.02</b> 33.51 2.12*	<b>2.23</b> 57.74 0.04	0.3302	0.2569
<b>Smart</b>	<b>6.77</b> 0.71 9.59***	<b>-6.77</b> 3.67 -1.85	<b>0.37</b> 1.53 0.24	<b>-2.77</b> 2.64 -1.05	<b>-5.15</b> 0.99 -5.16***	<b>5.15</b> 5.19 0.99	<b>-1.41</b> 2.17 -0.65	<b>1.65</b> 3.74 0.44	0.4005	0.3350
<b>Subaru</b>	<b>82.04</b> 4.17 19.67***	<b>4.96</b> 21.67 0.23	<b>-2.75</b> 9.06 -0.30	<b>17.46</b> 15.61 1.12	<b>-63.69</b> 5.90 -10.80***	<b>-14.30</b> 30.65 -0.47	<b>4.84</b> 12.81 0.38	<b>-21.31</b> 22.07 -0.97	0.7224	0.6920
<b>Suzuki</b>	<b>274.46</b> 20.72 13.25***	<b>15.54</b> 107.65 0.14	<b>41.40</b> 44.98 0.92	<b>-33.46</b> 77.52 -0.43	<b>58.23</b> 29.30 1.99	<b>-122.23</b> 152.25 -0.80	<b>-15.37</b> 63.62 -0.24	<b>-96.23</b> 109.63 -0.88	0.1235	0.0276

Significance codes: 0 \*\*\*; 0.001 \*\*, 0.01 \*

	<b>Intercept</b> (SD) (t-value)	<b>Pre-Policy</b> (SD) (t-value)	<b>Policy</b> (SD) (t-value)	<b>Post-Policy</b> (SD) (t-value)	<b>Country Variable</b> (SD) (t-value)	<b>DID1</b> <b>Pre-Policy</b> (SD) (t-value)	<b>DID2</b> <b>Policy</b> (SD) (t-value)	<b>DID3</b> <b>Post-Policy</b> (SD) (t-value)	<b>R2</b>	<b>Adj-R2</b>
<b>Škoda</b>	<b>4049.00</b> 119.00 34.02***	<b>-878.00</b> 618.50 -1.42	<b>-213.30</b> 258.40 -0.83	<b>883.00</b> 445.40 1.98	<b>-2996.60</b> 168.30 -17.80***	<b>391.60</b> 874.70 0.45	<b>422.00</b> 365.50 1.16	<b>-1279.40</b> 629.90 -2.03*	0.8735	0.8596
<b>Toyota</b>	<b>426.35</b> 19.65 21.70***	<b>-64.35</b> 102.10 -0.63	<b>-20.49</b> 42.66 -0.48	<b>-30.35</b> 73.52 -0.41	<b>-174.50</b> 27.79 -6.28***	<b>-51.50</b> 144.40 -0.36	<b>221.21</b> 60.34 3.67***	<b>73.00</b> 103.98 0.70	0.4623	0.4035
<b>Volvo</b>	<b>99.85</b> 6.39 15.63***	<b>-26.85</b> 33.20 -0.81	<b>34.30</b> 13.87 2.47*	<b>31.65</b> 23.91 1.32	<b>-61.00</b> 9.04 -6.75***	<b>27.00</b> 46.95 0.58	<b>-47.86</b> 19.62 -2.44*	<b>-49.50</b> 33.81 -1.46	0.6058	0.5627
<b>Volkswagen</b>	<b>914.38</b> 40.44 22.61***	<b>-354.38</b> 210.12 -1.69	<b>124.76</b> 87.80 1.42	<b>184.62</b> 151.30 1.22	<b>-527.77</b> 57.19 -9.23***	<b>168.77</b> 297.15 0.57	<b>-106.52</b> 124.17 -0.86	<b>-185.23</b> 213.97 -0.87	0.6823	0.6476

Significance codes: 0 \*\*\*; 0.001 \*\*; 0.01 \*

# References

## Literature

Abadie, A., & Gardeazabal, J. (2003). The economic costs of conflict: A case study of the Basque Country. *American economic review*, 93(1), 113-132.

Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program. *Journal of the American statistical Association*, 105(490), 493-505.

Aldred, R., & Tepe, D. (2011). Framing scrappage in Germany and the UK: from climate discourse to recession talk?. *Journal of Transport Geography*, 19(6), 1563-1569.

Barjoveanu, G., Dinita, F., & Teodosiu, C. (2022). Aging Passenger Car Fleet Structure, Dynamics, and Environmental Performance Evaluation at the Regional Level by Life Cycle Assessment. *Sustainability*, 14(14), 8443.

Böckers, V., Heimeshoff, U., & Müller, A. (2012). *Pull-forward effects in the German car scrappage scheme: a time series approach* (No. 56). DICE Discussion Paper.

Brand, C., Anable, J., & Tran, M. (2013). Accelerating the transformation to a low carbon passenger transport system: The role of car purchase taxes, feebates, road taxes and scrappage incentives in the UK. *Transportation Research Part A: Policy and Practice*, 49, 132-148.

Cantos-Sánchez, P., Gutiérrez-i-Puigarnau, E., & Mulalic, I. (2018). The impact of scrappage programmes on the demand for new vehicles: Evidence from Spain. *Research in Transportation Economics*, 70, 83-96.

D'Adamo, I., Gastaldi, M., & Rosa, P. (2020). Recycling of end-of-life vehicles: Assessing trends and performances in Europe. *Technological Forecasting and Social Change*, 152, 119887.

Eurostat (2023). Passenger cars in the EU. (on-line), available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger\\_cars\\_in\\_the\\_EU#Highest\\_share\\_of\\_passenger\\_cars\\_over\\_20\\_years\\_old\\_in\\_Poland](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU#Highest_share_of_passenger_cars_over_20_years_old_in_Poland)

Eurostat (2023). End-of-life vehicle statistics. (on-line), available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life\\_vehicle\\_statistics#Compliance\\_with\\_targets\\_on\\_reuse.2Freycling\\_and\\_reuse.2Frecovery\\_for\\_end-of-life\\_vehicles](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life_vehicle_statistics#Compliance_with_targets_on_reuse.2Freycling_and_reuse.2Frecovery_for_end-of-life_vehicles)

EEA (2022). New registrations of electric vehicles in Europe. (on-line), available at: <https://www.eea.europa.eu/ims/new-registrations-of-electric-vehicles>

EEA (2022). CO2 performance of new passenger cars in Europe. (on-line), available at: <https://www.eea.europa.eu/ims/co2-performance-of-new-passenger>

Fausto, B. A., & Tefft, B. C. (2018). Newer model years are associated with reduced risk of motor vehicle crash fatalities among older drivers. *Transportation research record*, 2672(33), 101-108.

Fraga, F. (2011). *Car Fleet Renewal Schemes: Environmental and Safety Impacts*. International Transport Forum.

Grigolon, L., Leheyda, N., & Verboven, F. (2016). Scrapping subsidies during the financial crisis—Evidence from Europe. *International Journal of Industrial Organization*, 44, 41-59.

Harvey, L. D. (2018). Resource implications of alternative strategies for achieving zero greenhouse gas emissions from light-duty vehicles by 2060. *Applied energy*, 212, 663-679.

Held, M., Rosat, N., Georges, G., Pengg, H., & Boulouchos, K. (2021). Lifespans of passenger cars in Europe: Empirical modelling of fleet turnover dynamics. *European Transport Research Review*, 13, 1-13.

Helmers, E., Leitão, J., Tietge, U., & Butler, T. (2019). CO2-equivalent emissions from European passenger vehicles in the years 1995–2015 based on real-world use: Assessing the climate benefit of the European “diesel boom”. *Atmospheric Environment*, 198, 122-132.

Hoekstra, M., Puller, S. L., & West, J. (2017). Cash for Corollas: When stimulus reduces spending. *American Economic Journal: Applied Economics*, 9(3), 1-35.

Buttigieg, D., Kingsbury, S., Griffiths, N., Valla, V., & Lieugaut, A. (2010a). *Assessment of the Effectiveness of Scrapping Schemes for Vehicles. Country Profile Annex*. IHS Global Insight.

Buttigieg, D., Kingsbury, S., Griffiths, N., Valla, V., & Lieugaut, A. (2010b). *Assessment of the Effectiveness of Scrapping Schemes for Vehicles. Economic, Environmental, and Safety Impacts*. IHS Global Insight.

Jiménez, J. L., Perdiguero, J., & García, C. (2016). Evaluation of subsidies programs to sell green cars: Impact on prices, quantities and efficiency. *Transport policy*, 47, 105-118.

Kagawa, S., Hubacek, K., Nansai, K., Kataoka, M., Managi, S., Suh, S., & Kudoh, Y. (2013). Better cars or older cars?: assessing CO2 emission reduction potential of passenger vehicle replacement programs. *Global Environmental Change*, 23(6), 1807-1818.

Kaul, A., Pfeifer, G., & Witte, S. (2016). The incidence of Cash for Clunkers: Evidence from the 2009 car scrappage scheme in Germany. *International Tax and Public Finance*, 23(6), 1093-1125.

Laborda, J., & Moral, M. J. (2019). Scrappage by age: Cash for Clunkers matters!. *Transportation Research Part A: Policy and Practice*, 124, 488-504.

- Lelli, M., Pede, G., Valentini, M. P., & Masoni, P. (2010). Car scrappage incentives policies: a life cycle study on GHG emissions. *WIT Transactions on Ecology and the Environment*, 131, 121-131.
- Lenski, S. M., Keoleian, G. A., & Bolon, K. M. (2010). The impact of ‘Cash for Clunkers’ on greenhouse gas emissions: a life cycle perspective. *Environmental Research Letters*, 5(4), 044003.
- Li, S., Linn, J., & Spiller, E. (2013). Evaluating “Cash-for-Clunkers”: Program effects on auto sales and the environment. *Journal of Environmental Economics and management*, 65(2), 175-193.
- Lüth, H. (2021). Reassessing car scrappage schemes in selected OECD countries: A synthetic control method application. *Diskussionspapier, No. 190*. Helmut-Schmidt-Universität – Universität der Bundeswehr Hamburg, Fächergruppe Volkswirtschaftslehre, Hamburg.
- Malecek, P., & Melcher, O. (2016). Cross-border effects of car scrapping schemes: the case of the German car scrapping programme and its effects on the Czech economy. *Prague Econ. Pap*, 25, 560-76.
- Marin, G., & Zoboli, R. (2020). Effectiveness of car scrappage schemes: Counterfactual-based evidence on the Italian experience. *Economics of Transportation*, 21, 100150.
- Mian, A., & Sufi, A. (2012). The effects of fiscal stimulus: Evidence from the 2009 cash for clunkers program. *The Quarterly journal of economics*, 127(3), 1107-1142.
- OECD / ITF (2011). Environmental and Safety Impacts. France, Germany and the United States. International Transport Forum, Paris. (on-line). Available at: <https://www.globalfueleconomy.org/media/44073/wp4-car-fleet-renewal-schemes.pdf>
- OECD (2023). OECD Statistics. (on-line). Available at: <https://stats.oecd.org/>
- Opatrný, M. (2021). Evaluating Economic Policy Using the Synthetic Control Method. Dissertation thesis. Institute of Economic Studies, Faculty of Social Sciences, Charles University Prague.
- Posada, F., Wagner, D. V., Basnal, G., & Fernandez, R. O. C. I. O. (2015). Survey of best practices in reducing emissions through vehicle replacement programs. *ICCT White Paper. ICCT, Washington, DC*.
- Romano, A., & Scandurra, G. (2012). The effectiveness of car scrapping schemes in the Italian market. *Advances in Methodology and Statistics*, 9(2), 175-190.
- Sturgeon, T., & Van Biesebroeck, J. (2010). Effects of the crisis on the automotive industry in developing countries: a global value chain perspective. *World Bank Policy Research Working Paper*, (5330).



Tan, R., Tang, D., & Lin, B. (2018). Policy impact of new energy vehicles promotion on air quality in Chinese cities. *Energy Policy*, 118, 33-40.

The World Bank (2023). DataBank. (on-line). Available at: <https://databank.worldbank.org/home>

Török, Á. (2020). A novel approach in evaluating the impact of vehicle age on road safety. *Promet-Traffic&Transportation*, 32(6), 789-796.

Van Wee, B., De Jong, G., & Nijland, H. (2011). Accelerating car scrappage: A review of research into the environmental impacts. *Transport Reviews*, 31(5), 549-569.

Wang, Y., Chang, X., Chen, Z., Zhong, Y., & Fan, T. (2014). Impact of subsidy policies on recycling and remanufacturing using system dynamics methodology: a case of auto parts in China. *Journal of Cleaner Production*, 74, 161-171.

## **Information sources on the scrappage scheme in each country**

*Abschlussbericht – Umweltprämie.* (2010). Bundesamt für Wirtschaft und Ausfuhrkontrolle.

*Aides à l'acquisition de véhicules propres.* (2013).

Auto, cronologia degli incentivi alla rottamazione. (2009, January 28). *Reuters*. <https://www.reuters.com/article/oitbs-factbox-incentivi-auto-storia-idITMIE50R0J820090128>

*Avances au fonds d'aide à l'acquisition de véhicules propres.* (2012).

*Bilancio Sociale di ACI.* (2010). Automobile Club d'Italia.

Bundesgesetz, mit dem eine Ökoprämie für Fahrzeugtausch eingeführt wird (Ökoprämiengesetz), BgblA\_2009\_I\_28 (2009). [https://www.ris.bka.gv.at/Dokumente/BgblAuth/BgblA\\_2009\\_I\\_28/BgblA\\_2009\\_I\\_28.html](https://www.ris.bka.gv.at/Dokumente/BgblAuth/BgblA_2009_I_28/BgblA_2009_I_28.html)

Buttigieg, D., Kingsbury, S., Griffiths, N., Valla, V., & Lieugaut, A. (2010a). *Assessment of the Effectiveness of Scrapping Schemes for Vehicles. Country Profile Annex.* IHS Global Insight.

Buttigieg, D., Kingsbury, S., Griffiths, N., Valla, V., & Lieugaut, A. (2010b). *Assessment of the Effectiveness of Scrapping Schemes for Vehicles. Economic, Environmental, and Safety Impacts.* IHS Global Insight.

Car Scrappage Details Announced in Budget. (2009, December 9). *Money Guide Ireland*. <https://www.moneyguideireland.com/car-scrappage-details-announced-in-budget.html>

*Car Scrappage Scheme Deals for the Government UK Car Scrappage Scheme Incentive Allowance.* (2010, May 28). <https://web.archive.org/web/20100528152514/http://www.carscrappage.co.uk/>

Cash for old cars scheme relaunched. (2010, July 15). *Cyprus Mail*.

*Comunicat de presă privind demararea programului de înnoire a parcului auto național.* (2007a). Administrația Fondului pentru Mediu.

*Comunicat de presă privind derularea primei etape a Programului de înnoire a parcului auto național.* (2009a). Administrația Fondului pentru Mediu.

*Comunicat de presă privind finalizarea în anul 2008 a Programului de stimulare a înnoirii Parcului auto național.* (2008a). Administrația Fondului pentru Mediu.

*Comunicat de presă privind finalizarea Programului de înnoire a parcului auto național 2007.* (2007b). Administrația Fondului pentru Mediu.

*Comunicat de presă privind finalizarea Programului de stimulare a înnoirii parcului auto național 2009.* (2009b). Administrația Fondului pentru Mediu.

*Comunicat de Presa privind reluarea in anul 2008 a Programului de Stimulare a Innoirii Parcului Auto National.* (2008b). Administrația Fondului pentru Mediu.

*Comunicat de presă—3.000 de tichete valorice alocate pentru persoanele fizice în cadrul Programului "Rabla 2013". Finalizarea analizei dosarelor pentru persoanele juridice si institutiile publice în cadrul Programului "Rabla 2013".* (2013a). Administrația Fondului pentru Mediu.

*Comunicat de presă—Start la Programul „Rabla” 2012.* (2012). Administrația Fondului pentru Mediu.

*Comunicat de presă—Start la Programul 'Rabla 2013'.* (2013b). Administrația Fondului pentru Mediu.

Consejo de Ministros. (2013, October 24). *Ministerio de Industria, Comercio y Turismo—El Ministerio de Industria, Energía y Turismo amplía el PIVE para vehículos eficientes con otros 70 millones de euros.* <https://www.mincotur.gob.es/es-ES/GabinetePrensa/NotasPrensa/2013/Paginas/npplanpivecuatro.aspx>

Costas, J. (2008a, October 29). *El Gobierno mete marcha atrás: Habrá cambios en el Plan VIVE.* Motorpasión. <https://www.motorpasion.com/industria/el-gobierno-mete-marcha-atras-habra-cambios-en-el-plan-vive>

Costas, J. (2008b, November 18). *Las nuevas condiciones del Plan VIVE*. Motorpasión. <https://www.motorpasion.com/industria/las-nuevas-condiciones-del-plan-vive>

Costas, J. (2009, May 19). *Plan 2000E, guía práctica*. Motorpasión. <https://www.motorpasion.com/industria/plan-2000e-guia-practica>

Costas, J. (2012, November 19). *El Plan PIVE ha recibido 24.000 reservas de 75.000 posibles*. Motorpasión. <https://www.motorpasion.com/industria/el-plan-pive-ha-recibido-24-000-reservas-de-75-000-possibles>

Costas, J. (2013a, January 11). *El Plan PIVE agotó sus fondos hace horas*. Motorpasión. <https://www.motorpasion.com/industria/el-plan-pive-agoto-sus-fondos-hace-horas>

Costas, J. (2013b, February 1). *Plan PIVE 2013, detalles definitivos de la segunda fase del PIVE*. Motorpasión. <https://www.motorpasion.com/industria/plan-pive-2013-detalles-definitivos-de-la-segunda-fase-del-pive>

*De Nationale Sloopregeling*. (2011, October 6). <https://web.archive.org/web/20111006054309/http://www.nationalesloopregeling.nl/sloopregeling.html>

Decreto-Lei n.º 292-A/2000, no. 292-A/2000, Ministério da Administração Interna (2000). <https://dre.pt/dre/detalhe/decreto-lei/292-a-2000-232124>

Delco. (2012, September 27). *El Gobierno aprueba el Plan PIVE (nuevo plan Prever)*. Motorpasión. <https://www.motorpasion.com/industria/el-gobierno-aprueba-el-plan-pive>

*Direcția de Comunicare: Tichetele pentru Rabla sunt valabile până la 31 ianuarie 2011*. (2010). Ministerul Mediului, Apelor și Pădurilor.

*El Plan 2000E deja sin consumir 9 millones de su presupuesto total*. (2010, December 20). [elconfidencial.com. https://www.elconfidencial.com/economia/2010-12-20/el-plan-2000e-deja-sin-consumir-9-millones-de-su-presupuesto-total\\_269757/](https://www.elconfidencial.com/economia/2010-12-20/el-plan-2000e-deja-sin-consumir-9-millones-de-su-presupuesto-total_269757/)

*El Plan PIVE 5 agota el 98% de su presupuesto*. (2014, June 3). Autocasión. <https://www.autocasion.com/actualidad/noticias/el-plan-pive-5-acumula-171-478-reservas-validas-y-agota-el-98-de-su-presupuesto>

*El Plan Prever termina sin haber retirado de la circulación doscientos mil coches viejos*. (2007, November 10). *Diario Sur*. <https://www.diariosur.es/20071110/malaga/plan-prever-termina-haber-20071110.html>

End of the road for car scrappage scheme. (2011, June 30). *Raidió Teilifís Éireann*. <https://www.rte.ie/news/2011/0630/303070-cars/>

*Estos son los ocho planes del automóvil lanzados por el Gobierno desde 1994.* (2020, June 15). El Español. [https://www.elespanol.com/invertia/observatorios/movilidad/20200615/planes-automovil-lanzados-gobierno/497950416\\_0.html](https://www.elespanol.com/invertia/observatorios/movilidad/20200615/planes-automovil-lanzados-gobierno/497950416_0.html)

*European Motor Vehicle Parc 2010.* (2012). Asociación Española de Fabricantes de Automóviles y Camiones.

*Evaluatie subsidieregeling 'Tijdelijke Sloopregeling personen- en bestelauto's'* (NO39.004). (2010). MuConsult B.V. <https://zoek.officielebekendmakingen.nl/blg-87681.pdf>

*Évaluation économique du dispositif d'écopastille sur la période 2008-2012* (No. 84; Études & Documents). (2013). Commissariat général au développement durable. [https://web.archive.org/web/20140117060904/http://www.developpement-durable.gouv.fr/IMG/pdf/E\\_D84\\_Ecopastille.pdf](https://web.archive.org/web/20140117060904/http://www.developpement-durable.gouv.fr/IMG/pdf/E_D84_Ecopastille.pdf)

*Evoluția Programului de Stimulare a Înnoirii Parcului Auto Național 2005 – 2021.* (2022). Administrația Fondului pentru Mediu.

*Fleet Renewal Schemes in the European Union 2009.* (2010). The European Automobile Manufacturers' Association. [https://web.archive.org/web/20100613171023/http://www.acea.be/images/uploads/files/2010\\_0212\\_Fleet\\_Renewal\\_Schemes\\_2009.pdf](https://web.archive.org/web/20100613171023/http://www.acea.be/images/uploads/files/2010_0212_Fleet_Renewal_Schemes_2009.pdf)

*Ghid de finanțare din 10 decembrie 2009 a Programului de stimulare a înnoirii Parcului auto național,* Ministerul mediului (2009). <https://legislatie.just.ro/Public/DetaliiDocument/118091?isFormaDeBaza=True&rep=True>

*Ghid de finanțare din 14 mai 2013 a Programului de stimulare a înnoirii Parcului auto național,* Ministerul Mediului și Schimbărilor Climatice, GHID 14/05/2013 (2013). <https://legislatie.just.ro/Public/DetaliiDocument/147872?isFormaDeBaza=True&rep=True>

*Ghid de finanțare din 27 februarie 2020 a Programului de stimulare a înnoirii Parcului auto național 2020-2024,* Ministerul Mediului, Apelor și Pădurilor (2020). <https://legislatie.just.ro/Public/DetaliiDocument/265751>

*Global Economic Data, Indicators, Charts & Forecasts.* (2023). <https://www.ceicdata.com/en/>

HM Treasury. (2009). *Budget 2009. Building Britain's future. Economic and Fiscal Strategy Report and Financial Statement and Budget Report* (HC 407).

*Informácia o priebehu čerpania dotácie na nákup nového vozidla, pri súčasnej likvidácii starého vozidla k 31. 07. 2009* (Iniciatívny Návrh UV-24589/2009). (2009). Ministerstvo hospodárstva. <https://hsr.rokovania.sk/14544/b/>

*Informácia o priebehu čerpania dotácie na nákup nového vozidla, pri súčasnej likvidácii starého vozidla k 31. 12. 2009* (UV-8631/2010). (2010). Ministerstvo hospodárstva. [https://hsr.rokovania.sk/15184/21/-/](https://hsr.rokovania.sk/15184/21/)

Instituto para la Diversificación y el Ahorro de la Energía. (2015). *Lineas de Ayuda a la Renovación del Parque Circulante Gestionadas por IDAE*.

*La prime à la casse: Un tiers des immatriculations de voitures neuves des ménages en 2009, 2010* (Le point sur). (2010). (Paris), 2010.

Lampert, M. (2014). *Analyse der Ökoprämie 2009 in Bezug auf ihre Vor- und Nachteile*. Montanuniversität Leoben.

Lei n.º 60-A/2005, de 30 de dezembro, no. 60-A/2005, Assembleia da República (2005). <https://dre.pt/dre/detalhe/lei/60-a-2005-376234>

Lei n.º 64-A/2008, no. 94-A/2008, Assembleia da República (2008). <https://dre.pt/>

Lei n.º 72/2009, de 6 de agosto, no. 72/2009, Assembleia da República (2009). <https://dre.pt/dre/detalhe/lei/72-2009-494019>

Lei n.º 107-B/2003, no. 107-B/2003, Assembleia da República (2003). <https://dre.pt/>

Leonidou, L. (2008a, May 8). Government swamped with applications to offload old cars. *Cyprus Mail*.

Leonidou, L. (2008b, July 18). Huge success for incentives to take old cars off the roads. *Cyprus Mail*.

*Les comptes des Transports en 2008 (tome 2)* (Les Dossiers d'analyse Économique Des Politiques Publiques Des Transports). (2009). La Commission des comptes des transports de la Nation.

Marin, G., & Zoboli, R. (2020). Effectiveness of car scrappage schemes: Counterfactual-based evidence on the Italian experience. *Economics of Transportation*, 21, 100150. <https://doi.org/10.1016/j.ecotra.2019.100150>

Michel, L. (2014). *Bilan Stratégique du Rapport Annuel de Performances*.

*Ministère du Développement durable et des Infrastructures—Aide financière pour voitures à faibles émissions de CO2*. (2010, November 26). <https://web.archive.org/web/20101126143902/http://www.car-e.lu/>

Real Decreto 575/2013, de 26 de julio, por el que se regula la concesión directa de subvenciones del 'Programa de Incentivos al Vehículo Eficiente (PIVE-3)', Pub. L. No. Real Decreto 575/2013, BOE-A-2013-8189 55045 (2013). <https://www.boe.es/eli/es/rd/2013/07/26/575>

Real Decreto 35/2014, de 24 de enero, por el que se regula la concesión directa de subvenciones del ‘Programa de Incentivos al Vehículo Eficiente (PIVE-5)’, Pub. L. No. Real Decreto 35/2014, BOE-A-2014-835 5082 (2014). <https://www.boe.es/eli/es/rd/2014/01/24/35>

Real Decreto 525/2014, de 20 de junio, por el que se regula la concesión directa de subvenciones del ‘Programa de Incentivos al Vehículo Eficiente (PIVE-6)’, Pub. L. No. Real Decreto 525/2014, BOE-A-2014-6684 49245 (2014). <https://www.boe.es/eli/es/rd/2014/06/20/525>

Real Decreto 988/2014, de 28 de noviembre, por el que se modifica el Real Decreto 525/2014, de 20 de junio, por el que se regula la concesión directa de subvenciones del ‘Programa de Incentivos al Vehículo Eficiente (PIVE-6)’, Pub. L. No. Real Decreto 988/2014, BOE-A-2014-12412 97968 (2014). <https://www.boe.es/eli/es/rd/2014/11/28/988>

Real Decreto 124/2015, de 27 de febrero, por el que se regula la concesión directa de subvenciones del ‘Programa de Incentivos al Vehículo Eficiente (PIVE-7)’, Pub. L. No. Real Decreto 124/2015, BOE-A-2015-2117 19135 (2015). <https://www.boe.es/eli/es/rd/2015/02/27/124>

Real Decreto 380/2015, de 14 de mayo, por el que se regula la concesión directa de subvenciones del ‘Programa de Incentivos al Vehículo Eficiente (Pive-8)’, Pub. L. No. Real Decreto 380/2015, BOE-A-2015-5377 41829 (2015). <https://www.boe.es/eli/es/rd/2015/05/14/380>

Real Decreto 898/2009, de 22 de mayo, por el que se regula la concesión directa de subvenciones para la adquisición de vehículos, Plan 2000 E de apoyo a la renovación del parque de vehículos, Pub. L. No. Real Decreto 898/2009, BOE-A-2009-8551 43143 (2009). <https://www.boe.es/eli/es/rd/2009/05/22/898>

Real Decreto 1667/2009, de 6 de noviembre, por el que se modifica el Real Decreto 898/2009, de 22 de mayo, por el que se regula la concesión directa de subvenciones para la adquisición de vehículos, Plan 2000 E de apoyo a la renovación del parque de vehículos, y se amplía el número máximo de vehículos a financiar en 80.000 vehículos adicionales, Pub. L. No. Real Decreto 1667/2009, BOE-A-2009-17650 92952 (2009). <https://www.boe.es/eli/es/rd/2009/11/06/1667>

Resolución de 10 de febrero de 2010, de la Secretaría General de Industria, por la que se publica el Acuerdo de Consejo de Ministros de 30 de diciembre de 2009, por el que se modifica la normativa reguladora de los préstamos previstos en el Plan elaborado por el Ministerio de Industria, Turismo y Comercio para la renovación del parque automovilístico (Plan VIVE 2008-2010), Pub. L. No. Resolución, BOE-A-2010-2528 14279 (2010). [https://www.boe.es/eli/es/res/2010/02/10/\(1\)](https://www.boe.es/eli/es/res/2010/02/10/(1))

*Ministrul László Borbély a declarat la Targu Mures ca valabilitatea tichetelor valorice din programul Rabla se prelungeste.* (2011a). Administrația Fondului pentru Mediu.

Ordonanță de urgență nr. 4 din 14 februarie 2007 privind reluarea pentru anul 2007 a Programului de stimulare a înnoirii Parcului auto național, Guvernul, OUG 4/2007 (2007). <https://legislatie.just.ro/Public/DetaliiDocumentAfis/79695>

Ordonanță de urgență nr. 38 din 24 mai 2006 privind reluarea pentru anul 2006 a Programului de stimulare a înnoirii Parcului național auto, Guvernul, OUG 38/2006 (2006). <https://legislatie.just.ro/Public/DetaliiDocumentAfis/72264>

Ordonanță de urgență nr. 50 din 21 aprilie 2008 pentru instituirea taxei pe poluare pentru autovehicule, OUG 50/2008 (2008). <https://legislatie.just.ro/Public/DetaliiDocument/91845?isFormaDeBaza=True&rep=True>

Ordonanță de urgență nr. 99 din 10 noiembrie 2004 privind instituirea Programului de stimulare a înnoirii Parcului național auto, Guvernul, OUG 99/2004 (2004). <https://legislatie.just.ro/Public/DetaliiDocument/56990?isFormaDeBaza=True&rep=True>

*Plan de relance de l'économie.* (2010).

*Plan de relance de l'économie.* (2011).

Portaria n.º 468/2010, no. 468/2010, Ministérios das Finanças e da Administração Pública, da Economia, da Inovação e do Desenvolvimento e das Obras Públicas, Transportes e Comunicações (2010). <https://dre.pt/>

*Prime CAR-e voitures électriques* (CdM/24/01/13-13-3; Les Avis de La Chambre Des Métiers). (2013). Chambre des Métiers.

*Programul RABLA pentru persoanele fizice demarează miercuri, 16 martie.* (2011b). Administrația Fondului pentru Mediu.

Răceanu, A. (2014). Romanian Scrappage Program 2005-2013. An Incremental Public Policy. *Management Dynamics in the Knowledge Economy*, 2(1), 181–211.

*Raportul privind utilizarea FM in anul 2005.* (2006). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2006.* (2007). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2007.* (2008). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2008.* (2009). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2009.* (2010). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2010.* (2011). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2011.* (2012). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2012.* (2013). Administrația Fondului pentru Mediu.

*Raportul privind utilizarea FM in anul 2013.* (2014). Administrația Fondului pentru Mediu.

*Referencia del Consejo de Ministros.* (2008).  
<https://www.lamoncloa.gob.es/consejodeministros/referencias/Paginas/2008/refc20080627.aspx>

*Relatório de Atividade 2009.* (2010). Valorcar – Sociedade de Gestão de Veículos em Fim de Vida.

*Relatório de Atividade 2010.* (2011). Valorcar – Sociedade de Gestão de Veículos em Fim de Vida.

Remo. (2012, October 4). *Comparativa entre el Plan PIVE, Plan 2000E y Plan VIVE de ayuda a la compra de vehículos.* Motorpasion.  
<https://www.motorpasion.com/industria/comparativa-entre-el-plan-pive-plan-2000e-y-plan-vive-de-ayuda-a-la-compra-de-vehiculos>

Resolución de 12 de abril de 2013, de la Secretaría de Estado de Energía, por la que se publica la de 20 de marzo de 2013, del Consejo de Administración del Instituto para la Diversificación y Ahorro de la Energía, por la que se modifican las bases reguladoras de la segunda convocatoria de ayudas del Programa de Incentivos al Vehículo Eficiente (PIVE-2), aprobadas por Resolución de 30 de enero de 2013., BOE-A-2013-4165 (2013).  
[https://www.boe.es/diario\\_boe/txt.php?id=BOE-A-2013-4165](https://www.boe.es/diario_boe/txt.php?id=BOE-A-2013-4165)

Resolución de 28 de septiembre de 2012, de la Secretaría de Estado de Energía, por la que se publica la de 24 de septiembre de 2012, del Consejo de Administración del Instituto para la Diversificación y Ahorro de la Energía, por la que se establecen las bases reguladoras para la convocatoria de ayudas del Programa de Incentivos al Vehículo Eficiente., BOE-A-2012-12216 (2012). [https://boe.es/diario\\_boe/txt.php?id=BOE-A-2012-12216](https://boe.es/diario_boe/txt.php?id=BOE-A-2012-12216)

Resolución de 31 de enero de 2013, de la Secretaría de Estado de Energía, por la que se publica la de 30 de enero de 2013, del Consejo de Administración del Instituto para la Diversificación y Ahorro de la Energía, por la que se establecen las bases reguladoras de la segunda convocatoria de ayudas del ‘Programa de Incentivos al Vehículo Eficiente (PIVE-2)’, BOE-A-2013-1092 (2013).  
[https://www.boe.es/diario\\_boe/txt.php?id=BOE-A-2013-1092](https://www.boe.es/diario_boe/txt.php?id=BOE-A-2013-1092)

Rosa, J. F. C. (2009). *Gestão de veículos em fim de vida: Do contexto internacional à realidade portuguesa.*  
<https://typeset.io/pdf/gestao-de-veiculos-em-fim-de-vida-do-contexto-internacional-30dbylluyi.pdf>

Sabelli, R. (2007, January 8). *INCENTIVI 2007. ROTTAMAZIONE AUTO, INTERVENTI SULLA CASA PER IL RISPARMIO ENERGETICO.*  
[https://sosonline.aduc.it/scheda/incentivi+finanziaria+2007+rottamazione+auto\\_11253.php](https://sosonline.aduc.it/scheda/incentivi+finanziaria+2007+rottamazione+auto_11253.php)



Sabelli, R. (2008, January 8). *INCENTIVI 2008: ROTTAMAZIONE AUTO, INTERVENTI SULLA CASA E 'BONUS' FISCALI*. [https://sosonline.aduc.it/scheda/incentivi+2008+rottamazione+auto+interventi+sulla\\_13051.php](https://sosonline.aduc.it/scheda/incentivi+2008+rottamazione+auto+interventi+sulla_13051.php)

Sabelli, R. (2009, February 13). *INCENTIVI 2009: ROTTAMAZIONE AUTO, MOTO, ED ACQUISTO MEZZI ECOLOGICI, BICICLETTE, CICLOMOTORI*. [https://sosonline.aduc.it/scheda/incentivi+2009+rottamazione+auto+moto+acquisto\\_15205.php](https://sosonline.aduc.it/scheda/incentivi+2009+rottamazione+auto+moto+acquisto_15205.php)

Scrappage Scheme Extended to June 2011. (2010, December 8). *Money Guide Ireland*. <https://www.moneyguideireland.com/scrappage-scheme-extended-to-june-2011.html>

Seijo, D. (2008, August 1). *Plan VIVE, guía práctica*. Motorpasión. <https://www.motorpasion.com/industria/plan-vive-guia-practica>

*Últimos coletazos del Plan 2000E: La venta de coches aún crece un 25%, Empresas, expansion.com.* (2010, January 7). Expansión. <https://www.expansion.com/2010/07/01/empresas/auto-industria/1277976385.html>

*VDA—Finanzmarktkrise verunsichert Autokäufer.* (2013, November 2). <https://web.archive.org/web/20131102184607/http://www.vda.de/de/meldungen/archiv/2008/10/14/2133/>

Výnos č. 3/2009, ktorým sa mení výnos Ministerstva hospodárstva Slovenskej republiky č. 1/2005 o poskytovaní dotácií v pôsobnosti Ministerstva hospodárstva Slovenskej republiky v znení neskorších predpisov úplné a aktuálne znenie, no. 3/2009, Ministerstvo hospodárstva Slovenskej republiky (2009). <https://www.aspi.sk/products/lawText/1/68420/1/2>

Výnos ministerstva hospodárstva o šrotovnom, no. 2/2009, Ministerstvo hospodárstva Slovenskej republiky (2009). <https://ekonomika.pravda.sk/ludia/clanok/190543-vynos-ministerstva-hospodarstva-o-srotovnom/>

*Απόσυρση αυτοκινήτων τέλος, αποφάσισε σήμερα η κυβέρνηση.* (2009a, November 2). TO BHMA. <https://www.tovima.gr/2009/11/02/society/b-aposyrsi-aytokinitwn-telos-apofasise-simera-i-kybernisi-b-2/>

*Δελτίο Τύπου.* (2009). ΣΕΕΑ – Σύνδεσμος Εισαγωγέων Αντιπροσώπων Αυτοκινήτων.

*Ετήσια Έκθεση 2008 Υπουργείου Συγκοινωνιών και Έργων.* (2009). <http://www.mcw.gov.cy/mtcw/mtcw.nsf/home/home?opendocument>

*Η αγορά μετά τη μείωση του τέλους ταξινόμησης των ΙΧ.* (2009b, April 5). ΤΟ ΒΗΜΑ. <https://www.tovima.gr/2009/04/05/finance/i-agora-meta-ti-meiwsi-toy-teloys-taksinomisis-twn-ix/>

*Η μεγάλη απόσυρση.* (2009c, July 26). ΤΟ ΒΗΜΑ. <https://www.tovima.gr/2009/07/26/finance/i-megali-aposyrsi-2/>

*Μειώνεται κατά 50% το τέλος ταξινόμησης των ΙΧ για ένα τετράμηνο.* (2009). <https://www.e-kyklades.gr/travel/tourism?articleid=12308&categoryid=&lang=el&regionCd=>

*Σχέδιο Απόσυρσης και Αντικατάστασης Παλαιών Οχημάτων.* (2010). Τμήμα Οδικών Μεταφορών.