Subsidies and Household Technology Adoption: Evidence from the Belgian Auto Market

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Abstract

We use micro-level administrative data and a temporary regional electric vehicle (EV) purchase subsidy in Belgium to study how price incentives shape household technology adoption. EV demand shows substantial price sensitivity overall, but markedly less among the highest-income households. We find little evidence that consumers substitute from ineligible premium vehicle segments to eligible smaller cars, or that the policy accelerates scrappage of older vehicles. Counterfactual simulations indicate that a large share of the subsidy accrues to higher-income households that would likely have adopted EVs even in the absence of the program, resulting in a high fiscal cost per ton of carbon reduction. We find mixed evidence that the temporary subsidy program led to a permanent increase in the rate of EV adoption.

Keywords: electric vehicles, purchase subsidies, demand elasticity, household behavior.
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1. Introduction

Decarbonizing road transport is central to meeting climate targets. Passenger cars account for a substantial share of transport-related greenhouse gas emissions (IPCC, 2023). Battery electric vehicles (EVs) are widely viewed as the leading technological substitute for internal combustion engines, given their low lifecycle emissions. To accelerate mass market adoption, governments have introduced generous purchase incentives. Yet the optimal design of EV subsidies remains unsettled. In particular, while supply-side factors have received a lot of attention in the literature (e.g., Springel, 2021; Allcott et al., 2024*b*; Barwick et al., 2025), our understanding of the demand for the new technology and how it varies across households remains limited.[1] This makes it difficult to evaluate concerns about equity regarding how any subsidy-generated surplus is distributed (Borenstein and Davis, 2025). Furthermore, a limited knowledge of the demand curve limits the potential of counterfactual exercises.

In this paper, we study EV adoption and car portfolio management at the household level, by combining administrative data on the population of Belgian households with vehicle registration records. Our setting is the introduction of a regional EV purchase subsidy in Flanders in January 2024. The subsidy provided €5,000 to buyers of new EVs priced below €40,000, and €3,000 to buyers of second-hand EVs that had an original list price below €60,000. It was available only to Flemish residents, and not to households domiciled in one of the other two regions of Belgium (i.e., Brussels and Wallonia). We exploit this quasi-experimental policy discontinuity to estimate the overall price elasticity of demand, as well as heterogeneity in demand responses across income groups.

Our five main findings on the subsidies and EV demand are as follows. First, high income households have a stronger demand for EVs. They respond more to the subsidies and also capture a larger share of the surplus. Second, EVs in many cases seem to be a complement rather than a substitute to gas cars. We find that only 50% of purchased EVs replace an existing car, while the others are added to the household fleet. Third, we find suggestive evidence that producers responded to the €40,000 price cap by lowering prices. The price cap also attenuated the regressivity of the subsidy as high income households favor more expensive models. Fourth, we find limited evidence that the subsidy led to a more permanent shift in the adoption of EVs (e.g. due to learning or network effects). Fifth, we calibrate a discrete choice model to capture the stylized facts, and estimate that the implied cost of carbon of the policy was high.

Our empirical work relies on novel administrative microdata from the Belgian Statistical

[1] Davis, Li and Springel (2025) study how EV adoption varies with political sensitivities, while Allcott, Kwon and Snyder (2024) study the distributional impact of the Inflation Reduction Act using data from car dealers.

Office (Statbel) that link the universe of Belgian residents to the complete history of vehicle registrations. The resulting data set allows us to observe household income and other socio-demographic characteristics, monthly EV purchase decisions, and the evolution of each household's vehicle portfolio. We complement these administrative records with detailed catalog price information from automotive market research firm JATO Dynamics, which enables us to identify vehicle eligibility for the subsidy, and to examine pricing and sales patterns around the eligibility threshold.

We begin by estimating dynamic difference-in-differences specifications at the border municipality level to trace the evolution of EV purchases in treatment and control areas around the policy change. The event study estimates show no evidence of differential pre-trends, and a sharp and persistent increase in EV adoption in Flanders following the introduction of the subsidy. We then estimate heterogeneous responses across income groups using household-level models. EV adoption rises across the income distribution, with the subsidy having the strongest effect for higher-income households. However, because this is also the group with the most elevated baseline purchase rate, the estimated demand elasticity is actually lower for the highest income group.

Next, we examine demand substitution patterns and potential complementarities across vehicle fuel types. Using car model-level price data, we document that while sales of eligible EVs increase sharply in Flanders relative to other regions, sales of ineligible premium EVs remain strong as well. This suggests limited reallocation across vehicle segments. We then track the total number of cars owned by households before and after their EV purchase. Roughly half of households retire an existing vehicle upon acquiring an EV, while the remainder add the EV to their car stock. Importantly, this pattern does not change following the introduction of the subsidy, indicating that the policy increases adoption but does not significantly accelerate scrappage of older vehicles.

To quantify policy implications, we calibrate a discrete-choice model to the reduced-form demand response estimates. The model incorporates heterogeneous price sensitivity across income quartiles, and allows for a persistent post-subsidy shift in EV valuation. We use the calibrated framework to simulate counterfactual subsidy schemes and to evaluate distributional effects, the impact on emissions and the associated fiscal cost, and the longer-run impact on EV demand. This analysis yields three main insights. First, a large share of subsidy payments accrue to higher-income households that would have adopted even without the policy. Second, the reduction in emissions that the subsidy generates is very modest, meaning that the implied fiscal cost per ton of carbon reduction is high. Third, we find mixed evidence that the rate of EV adoption remained higher in Flanders after the expiration of the subsidy. We find higher EV purchase rates in Flanders for some time after the end of

the subsidy. At the same time, the registration of second hand cars, which have a shorter delivery lag than new cars, rapidly fell back to normal after the expiration of the subsidy.

Taken together, our findings highlight the trade-offs inherent in EV subsidy design. In the short run, broad purchase subsidies generate substantial fiscal costs and limited emissions reductions. In the longer run, however, they may contribute to the diffusion of cleaner technologies by shifting household preferences and accelerating the transition toward electric mobility. Our key contribution is to provide evidence on the heterogeneity in adoption patterns across households.

1.1. Related Literature

Our work relates to three broad strands of the literature.

First, the question of the design of EV subsidies has attracted considerable attention, with researchers focusing on network externalities (Springel, 2021; Remmy, 2022), carbon credits versus cash subsidies (Kwon, 2023), the design of subsidies to target actual car externalities (Allcott et al., 2024*b*), bans on gasoline vehicles (Holland, Mansur and Yates, 2021). Most of these studies are however concerned with supply-side features of the subsidy. Evidence on demand is generally aggregate, with e.g. Barwick et al. (2023) using country level data to study the pass-through of subsidies to consumers, and Fournel (2025) and Clinton and Steinberg (2019) use regional market data to calculate responses to the subsidy. Muehlegger and Rapson (2022) study a programme targeting low-income households in California. One of the reasons for the limited focus on demand heterogeneity is data, as data on sales is available but information on the buyers is limited (Grigolon, Reynaert and Verboven, 2018). Our contribution is to combine exhaustive, household level data with a quasi-experiment that allows to identify the heterogeneous responses of consumers—in the spirit of Allcott, Kwon and Snyder (2024), who obtain data on customers of a car dealer, but at a broader scale, covering the full population.

A second set of papers has provided some light on demand by using car loan data. Klee, Morse and Shin (2023) show that EV car borrowers are 29% less likely to default than comparable gasoline vehicle borrowers, and obtain an interest rate that is 2 percentage points lower than those for similar gasoline cars. Bena, Bian and Tang (2023) similarly documents differences in interest rates across loan contracts, with a particular role for the used car market. Akbaripour et al. (2025) use bank data to explore how consumers respond to a green loan program and show that gas expenditures fall after the purchase. We complement their work by providing an exhaustive picture of households' EV consumption choices.

Last but not least, our work ties to a broader set of papers looking at green subsidies more generally, with e.g. Borenstein and Davis (2025) studying the incidence of the different types

of subsidies (e.g. for home renovations, solar panels or cars), Bellon et al. (2024) looking at loans for climate-proofing, and Feger, Pavanini and Radulescu (2022) studying household choices of solar panels.

2. Institutional Background and Empirical Design

2.1. The Belgian Car Market

Belgium has seen strong growth in electric car purchases and a significant decline in petrol and diesel car purchases in recent years, as shown in Figure 1a. In 2022, there were around 360,000 new car registrations of which roughly a third consisted of electric and hybrid cars. Company cars, that are often provided to employees as an in-kind (non-taxable) benefit, play an important role in the Belgian car market. In particular, most government efforts to support the transition to electric vehicles have focused on company cars, notably through tax advantages, such as the progressive reduction in the tax deductibility of petrol and diesel cars for companies (ACEA, 2022). As a result, company cars account for most of the registrations of new electric vehicles, with 87% of new electric cars in 2023 that are purchased by companies (Figure 1b). The picture however changes substantially when we consider the stock of cars instead of the flows. As shown in Figure 1c, the bulk of the stock of cars still belong to private individuals. For this segment, very few cars are electric. Therefore, while the transition in company cars is ongoing, it is important to understand the transition to electric cars for private individuals, which is the focus of this paper.

[Insert Figure 1 about here]

2.2. EV Subsidy Scheme

To study the market impact of subsidies, we exploit a regional scheme introduced by the Flemish government in January 2024. Belgium is divided into three regions and Flanders accounts for about 60% of the country's population. Under the scheme, any household residing in Flanders was eligible to receive a subsidy for the purchase of an electric vehicle.[2] Eligibility was subject to a price ceiling of €40,000 for new vehicles and an original list price of €60,000 for second-hand vehicles aged between three and eight years. The subsidy amounted to €5,000 for new vehicles and €3,000 for eligible second-hand vehicles purchased by natural persons. While the scheme was also available, under specific conditions, to non-profit organizations, small and medium enterprises, and car-sharing companies, we focus on subsidies to natural persons (private individuals).

[2]Hydrogen (fuel-cell) vehicles are also eligible but sales are negligible in practice. Hybrid vehicles are not eligible for the subsidy.

The subsidy was granted directly to consumers. While dealers typically advertised the scheme through their own communication channels, buyers were required to submit an application on the official government website after purchase and received the subsidy only upon approval. First announced in September 2023, the scheme came into effect on January 1, 2024 and was phased out on November 23, 2024; vehicles purchased or ordered before that date remained eligible for the subsidy even if the application was submitted afterward.

2.3. Identification

The Flemish policy is an interesting laboratory because it only applies to a subset of Belgian households, determined by their place of residence. With the granular household data, this allows to compare households with similar characteristics exposed or not to the treatment. To address concerns that unobservable geographic patterns may act as confounders, we also consider specifications using only the municipalities around the regional border. This is a largely integrated economic zone with similar labor market conditions, transportation infrastructure, and cultural preferences, which further ensures clean identification of the impact of the subsidy on EV sales volume.

We investigate the impact of the subsidy at two different levels. First, the municipality-level analysis provides a general perspective on how widespread EV purchases are, and how adoption evolves over time in response to the policy. Second, the household-level analysis examines heterogeneity in responses to the subsidy scheme as a function of socio-economic characteristics.

At the municipality level, we implement a dynamic difference-in-differences (DiD) (event-study) design using monthly electric vehicle purchases observed from January 2023 to December 2024, covering the 12 months before and 12 months after the introduction of the subsidy on January 1, 2024.[3] The Electric Vehicle Purchase Rate is defined as the share of households (%) in a municipality that purchase an electric vehicle in a given month. We compare the dynamic evolution of purchase rates in treated municipalities (located in Flanders) to those in control municipalities (located in Brussels and Wallonia). This comparison is conducted both across all Belgian municipalities and, more narrowly, among municipalities situated along the administrative border separating Flanders and Wallonia, as illustrated in Figure 2.

The household-level analysis applies the same dynamic (DiD) framework but uses households as the unit of observation. This choice reflects the fact that vehicle purchase decisions are typically made at the household level rather than by individuals. Using household-month

[3]We will use the term "purchases" for clarity. What we actually observe are car registrations which happen upon delivery of the vehicle.

administrative data allows us to exploit the granularity of the data to examine heterogeneity in responses to the subsidy across households with different income level.

[Insert Figure 2 about here]

2.4. Data

The analysis is based on administrative data sources that were gathered from two datasets by Statbel, the National Statistical Office of Belgium. First, the socio-economic dataset contains individual information about all the people who are registered in the National Population Register. Variables of particular interest are labor income, a flag for the presence of a salary car as a benefit in kind (both extracted from fiscal forms submitted by employers), employment status, home ownership, and educational attainment (all three extracted from the Census 2021). Moreover, a household identifier created using the National Register of Population enables to group individuals by household in order to compute aggregate variables such as households size and family structure.

Second, the vehicle registration dataset contains individual information about all vehicles registered in Belgium, by private individuals or by legal entities, from 1956 to 2024. Variables of particular interest are date of registration, make, model, fuel type, engine size, gross weight and, for most recent vehicles, emissions standards. We can link this database to the previously discussed one based on an identifier at the level of the individual. Vehicles owned by individual household members are aggregated to form a household-level car portfolio.

Third, to estimate the price of cars from the Statbel vehicle dataset, we use data from a private data provider, JATO Dynamics. The database includes sales, catalog prices, year of sales, make, model and version of all cars sold between 2012 and 2024 of major sixteen brands in the Belgian car market: Audi, BMW, Citroen, Dacia, Ford, Hyundai, Mercedes, Nissan, Opel, Peugeot, Renault, Skoda, Tesla, Toyota, Volkswagen, Volvo. According to industry organization FEBIAC, these sixteen makes (brands) accounted for 82.3% of the Belgian car market in 2022. Car price data are merged with the administrative vehicle registration data using vehicle make and model, and, when available, more detailed version information such as engine size. As the administrative data is inputted directly by the car dealers, some standardization of make and model names is necessary. Appendix B provides more information on the merge between the two datasets.

3. Empirical Framework and Results

In this section, we provide empirical evidence on the impact of the Flemish subsidy on electric vehicle adoption. We begin by documenting aggregate patterns in EV purchases

across municipalities in Belgium and in municipalities located along the regional border. We then introduce the empirical framework and present difference-in-differences estimates for the full sample of households as well as by income group. Finally, we use the estimated policy effects to derive implied demand elasticities for electric vehicles.

3.1. Aggregate Patterns in EV Adoption

Figure 3 plots the evolution of electric vehicle purchases over the period surrounding the subsidy program. For each municipality and month, we construct the Electric Vehicle Purchase Rate, defined as the share of resident households that register the purchase of at least one electric vehicle in that month. Municipalities are the smallest administrative subdivisions in Belgium, making them a natural unit of analysis for capturing local variation in EV adoption while allowing us to document aggregate regional patterns. We then average this rate across municipalities within each region, distinguishing between municipalities located in Flanders (treated group) and those located in the other regions (control group).

Panel (a) shows that, prior to the introduction of the subsidy in January 2024, EV purchase rates followed broadly similar and relatively stable trends across regions. Following the policy introduction, municipalities in Flanders exhibit a marked increase in EV adoption relative to municipalities in the control regions. Panel (b) presents the same exercise restricting the sample to municipalities located along the linguistic border. Despite the smaller sample size and greater volatility, the divergence in EV adoption after the policy introduction remains visible. Overall, these descriptive patterns suggest that the subsidy may have contributed to an acceleration in EV adoption in the treated region, a hypothesis that we examine more formally using a difference-in-differences framework in the next subsection.

[Insert Figure 3 about here]

3.2. Empirical Framework

Having documented suggestive municipality-level patterns in EV adoption, we now formalise the empirical strategy used to identify the causal impact of the subsidy at the household level. The household-month framework allows us to exploit cross-border variation in policy exposure while controlling for rich demographic characteristics and time effects. To strengthen identification, we restrict the sample to households residing in municipalities located along the regional border. Within this setting, we estimate a dynamic difference-in-differences specification to trace the evolution of EV purchase behaviour around the introduction and subsequent phase-out of the subsidy.

The outcome variable, $Y_{h,t}$, is an indicator equal to one if household h purchases at least one electric vehicle in month t, and zero otherwise. We estimate the specification for the full border sample and separately by income group.

$$Y_{h,t} = \sum_{j \neq -1} \alpha_j \left(\text{Flanders}_h \times \mathbb{1}\{\tau_t = j\} \right) + \mu_{p(h)} + \lambda_{y(t)} + \eta_{m(t)} + \theta' X_{h,t} + \varepsilon_{h,t}, \tag{1}$$

where τ_t denotes month t relative to the introduction of the subsidy in January 2024, and $j = -1$ (December 2023) is omitted as the reference period. The coefficients α_j therefore trace the dynamic difference in EV purchase probabilities between households in Flanders and households in neighboring control areas over event time. The specification includes province fixed effects $\mu_{p(h)}$, year fixed effects $\lambda_{y(t)}$, and calendar-month fixed effects $\eta_{m(t)}$. The vector $X_{h,t}$ includes household-level control variables, namely the number of employed household members, log household income, the number of salary cars, the number of children, household size, the number of members with higher education, and the number of homeowners.

Information on income is available in the administrative data in the form of individual income brackets defined in intervals of €10,000, with the highest bracket being open-ended at the upper tail. We approximate individual income using the midpoint of the reported income bracket. For the open-ended top bracket, we impose the same interval width as for the lower brackets. Individual income is set to zero for children below working age and for inactive individuals recorded in income brackets starting at zero. Household income is constructed by aggregating midpoint-imputed individual incomes at the household level.

Households are grouped into income categories defined by quartile thresholds of the household income distribution among households residing in Flanders in 2023, prior to the introduction of the subsidy. These thresholds are held fixed throughout the sample period and applied to all households in both treated and control regions. Because household income is constructed from midpoint-imputed individual income brackets, a non-negligible share of households lies exactly at the cut-off values, resulting in groups of unequal size. We therefore interpret these categories as relative income groups rather than strict quartiles. This approach ensures that comparisons reflect differences in households positions within the income distribution rather than shifts in the distribution over time or across regions.

3.3. EV Adoption by Households

We first present baseline evidence on household EV purchasing behaviour before turning to the dynamic policy effects implied by the empirical framework. This descriptive step helps contextualise the magnitude of the estimated treatment effects and assess the comparability

of households across treated and control border regions prior to the policy.

Table 1 presents baseline summary statistics for the pre-policy period. Monthly EV purchase probabilities are low in both regions, with slightly higher baseline adoption outside Flanders. Households in Flanders exhibit somewhat higher income levels, greater access to salary cars, and a larger number of employed members, while other observable demographic characteristics are broadly comparable across regions.

Figure 4 reports event-study estimates for households residing in border municipalities. The coefficients show no evidence of differential pre-treatment trends in EV adoption prior to January 2024, supporting the parallel trends assumption. Following the introduction of the subsidy, EV purchases increase markedly, with positive effects emerging immediately and remaining statistically significant throughout most of the subsidy period. The estimated effects attenuate after the policy is phased out in late 2024.

[Insert Table 1 about here]

[Insert Figure 4 about here]

3.4. Heterogeneity Effects by Income Group

While the previous results document a clear average increase in EV adoption following the subsidy, policy impacts may differ substantially across households depending on their financial resources and socio-economic characteristics. We therefore next examine heterogeneity in the dynamic treatment effects across income groups.

Table 2 reports descriptive statistics by income group for households residing in border municipalities. The table documents substantial socio-economic differences along the income distribution. EV purchase probabilities increase monotonically across income groups, with adoption rates more than quadrupling between the lowest and highest income categories. Higher-income households are also characterised by greater labour market participation, larger household size, and significantly higher access to salary cars. In addition, the prevalence of higher education and homeownership rises sharply with income. These systematic gradients indicate that households differ markedly in both financial capacity and exposure to vehicle-related incentives, providing a descriptive backdrop for the heterogeneous policy responses documented in the event-study estimates.

The event-study estimates in Figure 5 reveal substantial heterogeneity in the response of EV purchases across income groups. While there is no clear evidence of differential pre-treatment trends for any group, the post-policy increase in EV adoption is markedly stronger for higher-income households. In particular, households in the top income group exhibit the largest and most persistent rise in EV purchases following the introduction of the subsidy,

whereas responses among lower-income households are more muted and short-lived. These patterns suggest that the effectiveness of the subsidy is uneven across the income distribution, consistent with differences in financial constraints, access to complementary resources such as charging infrastructure, or differential salience of purchase incentives.

[Insert Table 2 about here]

[Insert Figure 5 about here]

3.5. Implied Price Elasticities of EV Adoption

The event-study estimates reveal pronounced differences in the adoption response across income groups. To quantify the economic significance of these effects, we next compute implied price elasticities of demand for electric vehicles by relating the estimated causal change in EV adoption to the subsidy-induced price reduction. The elasticity is defined as

$$\varepsilon = \frac{\Delta Q}{\Delta P} \cdot \frac{P_0}{Q_0}. \tag{2}$$

where Q_0 denotes the pre-treatment baseline probability that a household in Flanders purchases an electric vehicle in a given month, and ΔQ is the treatment-induced change in this probability.

In the dynamic difference-in-differences framework, we measure Q_0 as the average monthly EV purchase probability among Flemish households during the twelve months preceding the introduction of the subsidy (calendar year 2023). The policy-induced change in adoption, ΔQ, is computed as the average of the post-treatment event-study coefficients $\hat{\alpha}_j$ over the subsidy period in 2024. To translate these effects into price responsiveness, we assume an average pre-subsidy vehicle price $P_0 = €40{,}000$ and a subsidy amount $S = €5{,}000$, implying a price reduction of 12.5%.

3.6. Car Prices

In the design of the subsidy, an important dimension in the purchase decision of the household is whether to choose a large or a small car, as only "small" cars with a price below €40,000 are eligible. In this subsection, we use the car prices data from JATO to explore sales and price patterns around the subsidy. The JATO data only includes the catalog prices by make, model and version and year. In practice, catalog prices often differ from transaction prices as car buyers negotiate discounts. In fact, the subsidies are allocated based on the transaction prices which are unfortunately not recorded in our administrative data (subsidies are provided by the regional administration while our data is national).

With this in mind, we first categorize electric cars depending on whether they are eligible to receive the subsidy or not. To identify eligible cars, we use a list of eligible car models from Egear.be, and categorize the model as eligible if they are in the list. We further check that there are no other EVs in Jato with a price below 40,000.

In Figure 6, we break down total sales of electric cars by eligibility status and region. Sales of eligible cars in Flanders jumped from around 2,700 units in 2023 to 10,400 units in 2024, an 285% increase. In contrast, sales of the same models in other regions increased by 12%. Interestingly, sales of premium electric cars, not eligible for the subsidy, remained relatively strong in Flanders, posting an increase to 3,690 units from 2,860 in 2023. Such an increase in sales of premium cars is also comparable to the premium sales other regions. This suggests that the spillovers of the subsidy across car categories were small, with consumers on the premium segment unwilling to substitute to cheaper models despite the subsidy. We will use this point later in the counterfactual analysis of section 4.

[Insert Figure 6 about here]

With this in mind, we then turn our attention to the behaviour of prices around the subsidy. While the literature has generally documented a positive pass-through of car subsidies to prices (see e.g. Barwick et al. 2023), we find that prices generally fell as the subsidy was implemented and the price threshold of €40,000 may have further contributed to lower prices. As a start, anecdotal evidence suggests that carmakers responded to the subsidy by reducing prices to be eligible for the subsidy. Volkswagen for instance announced in early 2024 a reduction in the prices of its ID.3 and ID.4 models to make them eligible for the subsidy.[4] While the prices in our data are not the final transacted price, the catalog prices nevertheless also exhibit a broad decline. Figure 7 illustrates this, showing prices for the top 7 models that are available in 2023 and 2024. For each model, the price is that of the "entry-level" version, thus the lowest price. Together, the 7 models cover more than half of the market (51%).

Car prices mostly fell in 2024. The Toyota BZ4X is an interesting illustration of responses to the subsidy: in 2023, the prices ranged from €55,000 for the basic version (BZ4X dynamic) to €68,000 for the most expensive (BZ4X AWD Premium). In 2024, Toyota lowered the price of its entry version to €39,590. As we show in the Appendix A Figure A8, this version in fact accounted for the bulk of sales in 2024 and sold more units in 2024 than all versions combined in 2023.

[4] See e.g. C. Westerheide, 11 January 2024, "VW cuts prices of its ID. models in several European markets", https://www.electrive.com/2024/01/11/vw-cuts-prices-of-its-id-models-in-several-european-markets/. Retrieved 24 July 2025.

For the other models, prices also fell in 2024. While this could also reflect global trends (as for instance Tesla decided to lower the prices of its main models globally in 2024, triggering talks of a "price war"), the figures however suggest an additional clustering of transactions and prices around the €40,000 threshold in 2024. For instance, Tesla's model Y had three versions in 2023, and the mid-range version with a price of €53,990 accounted for 58% of sales. In 2024, it is instead the lower priced version, at €42,990 that accounted for the bulk of sales (66%).

Similar trends are observed for other models, with transactions for Volkswagen's ID.3 for instance being relatively spread across the price range in 2023 (€38,000 to €60,000) but more concentrated in 2024, with 99% of transactions below €45,000 in 2024 versus 17% in 2023.

Our key takeaway from the analysis of prices are as follows. First, we do not observe a substantial weakening of the "premium" segment for electric cars in Flanders in 2024, suggesting a limited rebalancing of demand by the buyers of premium vehicles to the lower priced vehicles that are eligible for the subsidy. Second, the price of electric cars generally fell in 2024, reflecting both market trends and active pricing by carmakers to become eligible for the subsidies. Third, an important caveat is that we only observe the catalog (listed) price of the cars, instead of the transaction prices. Many cars in our data, such as the Tesla Model Y, were clearly eligible for the subsidy but displayed catalog prices above the 40,000 threshold, reverting instead to discounts which we do not observe. While Allcott et al. (2024*a*) have detailed data on car transactions, our comparative advantage is on the sociodemographic data and we therefore focus most of the later analysis on quantities sold, using the catalog prices in the calibration only as an input to categorize car as eligible for the subsidy or not.

[Insert Figure 7 about here]

3.7. Impact on car replacement patterns

Because the subsidy does not require households to scrap an existing vehicle, it is not clear whether a newly purchased electric car replaces a previous car or instead expands the households car stock. To examine this issue, we follow households that purchased an electric vehicle in 2023 or 2024 and track their total number of cars (including salary cars) as well as the number of electric cars on a monthly basis from six months before to six months after the purchase. While some households may dispose of their previous vehicle more than six months after acquiring a new one, data availability currently limits the observation window for households purchasing late in 2024. We therefore adopt a symmetric six-month event window.

Figure 8a presents the average evolution of total car ownership and electric car ownership for all Belgian households purchasing an electric vehicle in 2023 - 2024. Prior to the purchase, most households own roughly one car, typically a gasoline vehicle or a salary car, and almost no electric vehicles. At the time of purchase, the average number of electric cars increases sharply, while the total number of cars rises by less than one. This pattern indicates that roughly half of purchasing households replace an existing car, whereas the remainder add the electric vehicle to their existing stock. Car ownership remains broadly stable in the months following the purchase.

Selling a previous vehicle allows households to recover its residual value, thereby reducing the effective cost of acquiring a new, typically more expensive electric vehicle. This raises the question of whether the introduction of the €5,000 subsidy in Flanders in 2024 – available for electric cars priced up to €40,000, altered households replacement behaviour. Additional evidence reported in Appendix Figures A6 and A7, which distinguish purchases by year and region, shows that replacement versus expansion patterns are very similar across purchase cohorts and geographic areas. Consistent with this visual evidence, regression results presented in Tables A2 and A3 in Appendix A indicate no statistically significant differences. Overall, the subsidy does not appear to have materially affected households car replacement decisions.

A related question is whether the observed mix of replacement and stock expansion is specific to electric vehicle purchases or instead reflects a more general feature of household car demand. To address this, Figure 8b reports the corresponding event-study patterns for households purchasing a gasoline car during the same period. The results are remarkably similar: total car ownership increases by less than one at the time of purchase, suggesting that roughly half of households replace an existing gasoline car while the remainder retain it. As in the case of electric vehicles, these patterns are stable across regions and purchase years (see Appendix Figure A7). One notable difference is that most gasoline-car buyers already owned at least one gasoline vehicle prior to purchase, whereas electric-vehicle buyers are typically first-time adopters of this technology.

[Insert Figure 8 about here]

4. Policy Counterfactuals

To assess the impact of the EV subsidies on the broader car market and to evaluate alternative EV subsidy designs, we use a discrete-choice framework that captures the key decision margins highlighted by the policy. The model is designed to translate the reduced-form estimates of Section 3 into transparent counterfactual predictions, rather than to provide a fully

structural estimation of demand.

4.1. Framework

A household i that owns at least one car chooses among a finite set of mutually exclusive options j. Its first (outside) option, indexed $j = 0$, is not to purchase a new car. The household may alternatively choose to buy a new car. Each car is characterized by an engine type (internal combustion engine or battery electric), as well as a vehicle size (big or small). Figure 9 illustrates the decision problem. The distinction between small and large vehicles reflects subsidy eligibility, as only electric vehicles below a price cutoff qualify for the subsidy.

[Insert Figure 9 about here]

The indirect utility of option j in period t is given by

$$U_{ijt} = -\alpha_q(p_{jt} - \tau_{jt}) + \beta_q \cdot \mathbf{1}\{t > T\} \cdot \mathbf{1}\{j = \text{EV}\} + \xi_{jt} + \varepsilon_{ijt}, \tag{3}$$

where p_{jt} denotes the purchase price, τ_{jt} the subsidy amount, and $\alpha > 0$ governs price sensitivity. The term ξ_{jt} captures mean utility from non-price characteristics, while ε_{ijt} reflects household-specific tastes.

The price sensitivity α_q is specific to the income quartile of the household, $q(i)$. The parameters β_q allow the subsidy to have persistent effects beyond the last period of the subsidy T. This term captures a reduced-form shift in the relative attractiveness of electric vehicles following subsidy exposure and is identified from excess adoption after the expiration of the subsidy.

We assume a nested extreme value structure for ε_{ijt}, allowing for differential substitution patterns across fuel types and vehicle classes. Let

$$\delta_{jt} \equiv -\alpha(p_{jt} - \tau_{jt}) + \beta \mathbf{1}\{t > T\}\mathbf{1}\{j = \text{EV}\} + \xi_{jt} \tag{4}$$

be the average utility provided by option j in year t. The utility of the outside option is normalized to zero. Under the nested-logit assumption, market shares follow standard closed-form expressions, the model yields the standard nested-logit market share in each period

$$s_j = \frac{e^{\delta_j/(1-\sigma)}}{D_g^{\sigma} \sum_h D_h^{1-\sigma}},$$

with

$$D_g \equiv \sum_{j \in \mathcal{J}_g} e^{\delta_j/(1-\sigma)}.$$

where σ captures group-specific substitution patterns.

The framework relies on a number of key assumptions. First, we focus on households that already own at least one vehicle and model the decision as a replacement or addition choice. This reflects the empirical setting, in which nearly all EV purchases are first-time EV adoptions. Second, the model is static and abstracts from forward-looking behavior. Households do not anticipate future subsidies or strategically time purchases. These aspects are taken into account in the estimation of the parameters (our dif-in-dif reduced form estimates) and the goal is here to consider the implications of the estimates for the market under different scenarios. Third, the persistent preference parameter β_q is interpreted as a reduced-form object. It summarizes all channels through which subsidy exposure leads to sustained increases in EV adoption. Fourth, prices are taken as exogenous in the counterfactual simulations. While we document price adjustments around the subsidy threshold, we abstract from endogenous manufacturer pricing responses in order to keep the counterfactuals transparent and conservative.

The model parameters are calibrated to match the reduced-form moments estimated in Section 3. Our starting point is the Flemish market in 2023, broken down by income quartiles. We set the price sensitivity parameter α_q so that the model reproduces the estimated EV demand elasticities for each income quartile. The persistent preference parameter β_q is calibrated to match post-expiration excess EV adoption in Flanders relative to the control regions (in Figure 5). This ensures that the model reproduces the observed persistence in adoption after the subsidy ends.

The calibrated model allows to simulate alternative subsidy schemes, including changes in subsidy levels, eligibility thresholds, and targeted subsidies by income group. We focus on three aspects. First, we calculate the impact of the subsidy on sales of new EVs, considering the breakdown across vehicle sizes and income groups. Second, we analyze the implications of the changes in sales for the average emissions of the car stock. Finally, we quantify the permanent change in utility for EVs after the expiration of the subsidy.

4.2. Impact of the subsidy on EV sales

Figure 10 shows the sales of EVs with and without subsidy, broken down by income group. The sales without subsidy (the blue bars) are simply the total sales of EVs in Flanders in 2023, before the subsidy. Two patterns stand out. First, the sales are heavily skewed to higher income households. Before the subsidy, the top quartile accounts for 48% of EV sales while the bottom quartile only accounts for 10% of EVs sold (Figure 10a). Households with lower income are also more likely to buy smaller EVs (Figure 10b). This implies that

the subsidy is going to be heavily skewed towards the higher income groups. While the price threshold helps redirect some of the surplus to the lower income households (as higher income are more likely to buy non-eligible large cars), the top quartile still captures 43% of the subsidies. Second, a substantial share of the subsidies are distributed to households that would have bought anyhow. Our estimates indicate that the sales of EVs with the subsidy are of 10,200 cars relative to 8,400 cars sold in the absence of the subsidy, of which around 5,600 receive the subsidy (the rest are large EVs, ineligible).

[Insert Figure 10 about here]

This suggests that the subsidy does not target the marginal buyer (as more than half of the households who receive it would have bought an EV anyhow) and it is quite regressive.

4.3. Impact of the subsidy on carbon emissions

Next, we estimate the impact of the subsidy on the average emissions of the stock of privately owned cars in Flanders. To do this, we use the lifecycle greenhouse gas intensity estimates provided by the IPCC. The figures reflect the emissions over the entire life of the vehicle, including emissions during the production and end-of-life operations (e.g. dismantling, recycling), normalized by the transportation services (distance) provided by the vehicle. Table 3 provides the emission estimates of each vehicle type, in gCO_2-eq per vehicle-km, while Table A1 (in appendix) provides the full underlying figures from the IPCC. The IPCC calculates emissions for battery vehicles under different types of electricity production, and we use the most favorable case where the battery electric vehicles are powered using low carbon electricity. In this case most of the emissions are related to the production of the vehicle. Using back of the envelope calculations we then decompose these estimates into emissions for large and small vehicles (in practice, our estimates suggest that the emissions of small vehicles are around half of that of large vehicles). For the existing car stock, we assume that the emissions are 222 gCO_2-eq / km, which corresponds to the median emissions for gasoline cars.

[Insert Table 3 about here]

The second column in Table 3 then shows the market shares of each option (across all income groups). Around 11% of households buy a new car each year, while the others keep their current car. New car purchases of EVs account for only 0.3% of households each year. EV sales are thus marginal in the market for private cars in Flanders. Given this, it is clear that the subsidy can only have limited effects on the total emissions of the car stock: a 20%

increase in EV sales may be large for the EV market, but it is negligible at the aggregate level. Specifically, we find that the average emissions intensity of the car stock declines by 0.05% with the subsidy. Assuming total emissions from private cars in Flanders of 6.6Mt per year (equivalent to roughly 10% of total emissions in Flanders according to Statistics Flanders), the policy saves 0.3 Mton of CO_2 annually. If 5,600 households receive the subsidy, and cars have a lifetime of 10 years, the implied price per ton of carbon is of €856 per ton, way above prices in e.g. the Emissions Trading Scheme of the European Union.[5]

4.4. Permanent impact of temporary subsidies

We saw that the subsidies are coarse (not precisely targeted towards the marginal buyers) and regressive, and that their impact on total emissions is relatively limited. This mirrors findings in other contexts (see e.g. Jenn, Springel and Gopal 2018; Huse and Lucinda 2014). However the key argument for these subsidies is typically not that they are going to redistribute wealth or even directly reduce emissions. Rather, the stated aim is often to jump-start the market. If fixed costs are high (e.g. setting up a charging station at home) and network effects are strong (e.g. EVs require a reliable and extensive network of charging stations), the first entrants may encourage others to join later on, even when the subsidy has been phased out.

To gauge this effect, we consider the excess sales of EVs in Flanders in 2025, estimated by income group in Figure 5. From this, we then calibrate the permanent impact on average utility - the term $\beta_q \cdot \mathbf{1}\{t > T\} \cdot \mathbf{1}\{j = \text{EV}\}$ in equation (4). This can be expressed as a monetary-equivalent discount in the price of EVs that would generate the excess demand in 2025. Figure 11 shows the estimated values. The magnitudes are large, as the shift in sales patterns post-subsidy are equivalent to an increase in utility for EVs of more than €3,000 for the lower income households. The permanent impact is lower for the top income, at around €2,250.

[Insert Figure 11 about here]

All in all, while the direct and short term costs in terms of redistribution and efficiency seem relatively high, these results suggest that the subsidies may have indeed contributed to a change in consumer behaviour over the longer term, which could attenuate the unfavourable statistics computed earlier.

[5]With total expenses of €28.2 million, saving 3,300 tons of CO_2 each year, for ten years, the implied carbon price is $28.2/0.33/10 = e856$ per ton of CO_2.

5. Conclusion

This paper studies how households respond to price incentives in the private car market, using administrative data and the introduction of a regional EV purchase subsidy in Belgium. Exploiting the policy discontinuity between Flanders and the rest of the country, we document a large and persistent increase in EV adoption following the subsidys introduction, with no evidence of differential pre-trends. Implied demand elasticities are sizable and heterogeneous across income groups, indicating that households are highly responsive to price incentives when considering electric vehicles.

However, the counterfactual analysis highlights important trade-offs. A substantial share of subsidy payments accrue to households that would have adopted even in the absence of the policy, and substitution across vehicle segments is limited. As a result, the fiscal cost per ton of carbon abated is high, and transfers are skewed toward higher-income households. In the short run, broad purchase subsidies therefore appear to be a relatively blunt and costly instrument for reducing emissions.

At the same time, EV adoption remains elevated after the subsidy expires. The post-policy adoption pattern is consistent with a persistent increase in consumer valuation of EVs, suggesting that temporary subsidies may shift long-run demand and accelerate the technology transition. Taken together, our findings underscore a central tension in EV policy design: while purchase subsidies may be imperfect tools for immediate emissions reduction, they can contribute to longer-term diffusion of cleaner technologies. Designing policies that better target marginal adopters while preserving dynamic benefits remains an important challenge for future research and policy.

References

ACEA. 2022. "ACEA Tax Guide 2022."

Akbaripour, Navid, Marieke Bos, Ehsan Mahdikhani, and Arna Olafsson. 2025. "Green Loans and Household Behavior: Selection, Real Effects, and Windfalls."

Allcott, Hunt, Daniel Cohen, William Morrison, and Dmitry Taubinsky. 2024*a*. "When do" Nudges" Increase Welfare?"

Allcott, Hunt, Hyuk-soo Kwon, and Tess Snyder. 2024. "Equitable Energy Transitions? The Efficiency and Distributional Effects of Subsidies for Used Electric Vehicles." *SSRN Electronic Journal*.

Allcott, Hunt, Reigner Kane, Maximilian S Maydanchik, Joseph S Shapiro, and Felix Tintelnot. 2024*b*. "The effects of buy american: Electric vehicles and the inflation reduction act."

Barwick, Panle Jia, Hyuk-soo Kwon, Binglin Wang, and Nahim Bin Zahur. 2023. "Pass-through of Electric Vehicle Subsidies: A Global Analysis." *AEA Papers and Proceedings*, 113: 323–328.

Barwick, Panle Jia, Hyuk-Soo Kwon, Shanjun Li, and Nahim B Zahur. 2025. "Drive down the cost: Learning by doing and government policies in the global EV battery industry."

Bellon, Aymeric, Cameron LaPoint, Francesco Mazzola, and Guosong Xu. 2024. "Picking Up the PACE: Loans for Residential Climate-Proofing."

Bena, Jan, Bo Bian, and Huan Tang. 2023. "Financing the Global Shift to Electric Mobility."

Borenstein, Severin, and Lucas W Davis. 2025. "The Distributional Effects of US Tax Credits for Heat Pumps, Solar Panels, and Electric Vehicles." *National Tax Journal*, 78: 263–288. doi: 10.1086/733564.

Clinton, Bentley C, and Daniel C Steinberg. 2019. "Providing the Spark: Impact of financial incentives on battery electric vehicle adoption." *Journal of Environmental Economics and Management*, 98: 102255.

Davis, Lucas W, Jing Li, and Katalin Springel. 2025. "Political Ideology and U.S. Electric Vehicle Adoption." *National Bureau of Economic Research Working Paper Series*, No. 33591.

Feger, Fabian, Nicola Pavanini, and Doina Radulescu. 2022. "Welfare and Redistribution in Residential Electricity Markets with Solar Power." *The Review of Economic Studies*, 89(6): 3267–3302.

Fournel, Jean-François. 2025. "Electric Vehicle Subsidies: Cost-Effectiveness and Emission Reductions."

Grigolon, Laura, Mathias Reynaert, and Frank Verboven. 2018. "Consumer Valuation of Fuel Costs and Tax Policy: Evidence from the European Car Market." *American Economic Journal: Economic Policy*, 10(3): 193–225.

Holland, Stephen P, Erin T Mansur, and Andrew J Yates. 2021. "The Electric Vehicle Transition and the Economics of Banning Gasoline Vehicles." *American Economic Journal: Economic Policy*, 13(3): 316–344.

Huse, Cristian, and Claudio Lucinda. 2014. "The Market Impact and the Cost of Environmental Policy: Evidence from the Swedish Green Car Rebate." *The Economic Journal*, 124(578): F393–F419.

IPCC. 2023. "Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change." Intergovernmental Panel on Climate Change (IPCC).

Jenn, Alan, Katalin Springel, and Anand R. Gopal. 2018. "Effectiveness of Electric Vehicle Incentives in the United States." *Energy Policy*, 119: 349–356.

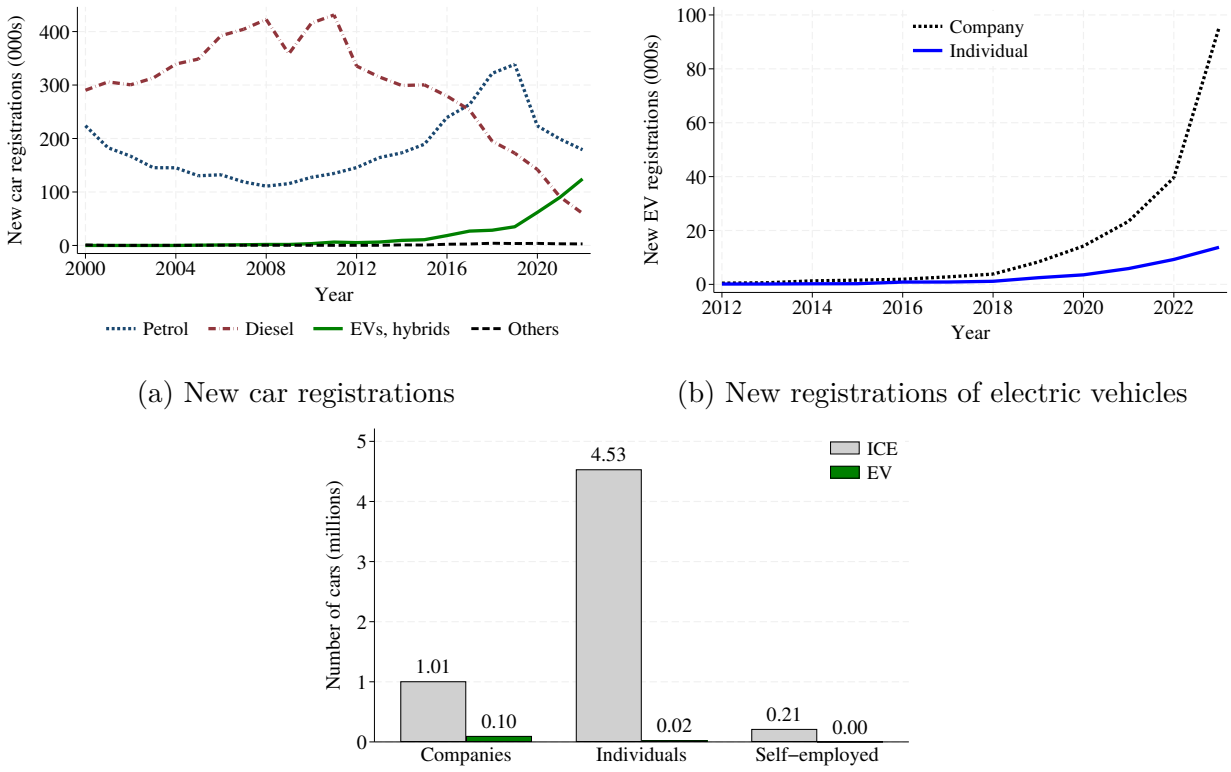
Klee, Elizabeth, Adair Morse, and Chaehee Shin. 2023. "Auto Finance in the Electric Vehicle Transition." *Available at SSRN 4642783*.

Kwon, Hyuk-soo. 2023. "Subsidies versus tradable credits for electric vehicles: The role of market power in the credit market."

Muehlegger, Erich, and David S Rapson. 2022. "Subsidizing low- and middle-income adoption of electric vehicles: Quasi-experimental evidence from California." *Journal of Public Economics*, 216: 104752.

Remmy, Kevin. 2022. "Adjustable product attributes, indirect network effects, and subsidy design: The case of electric vehicles."

Springel, Katalin. 2021. "Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives." *American Economic Journal: Economic Policy*, 13(4): 393–432.



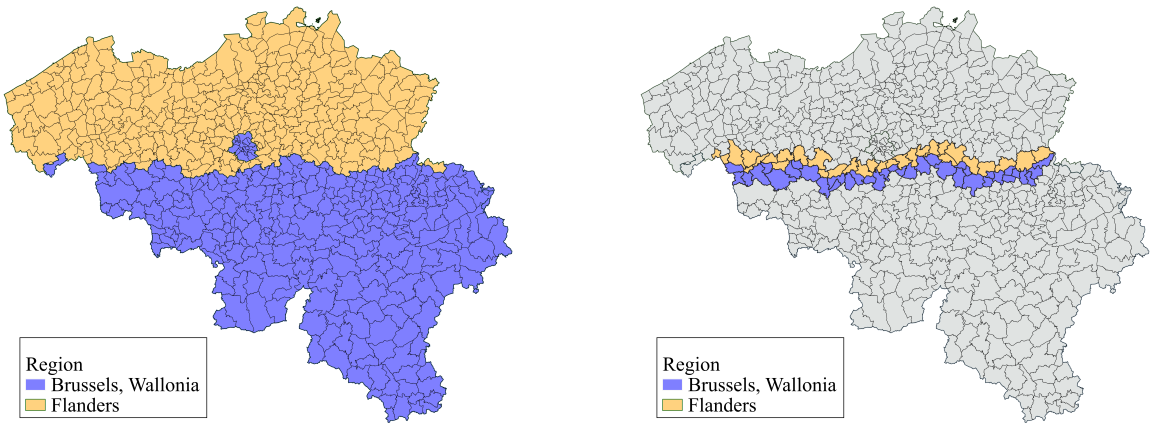
(a) New car registrations

(b) New registrations of electric vehicles

(c) Car fleet in Belgium

Figure 1: Overview of the Belgian car market

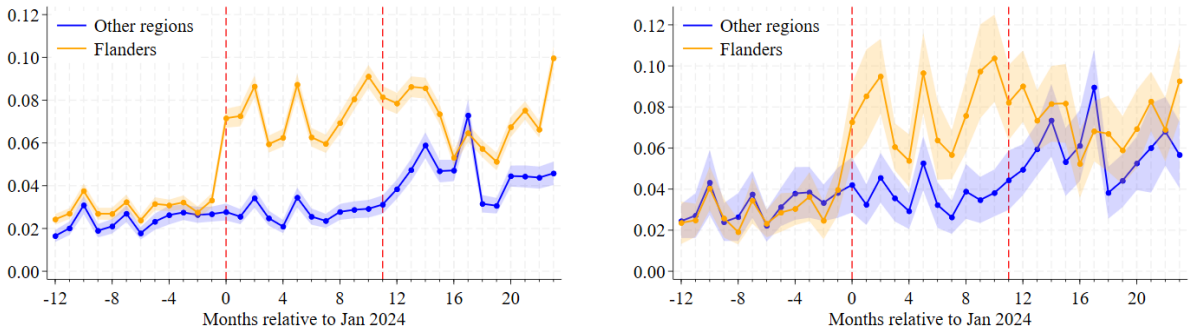
Subfigure 1a shows the number of new car registrations by fuel type: gasoline (dotted blue line), diesel (dashed dotted red line), battery electric and hybrid electric (solid green line), and others (dashed black line) from 2000 to 2022 in Belgium. Data source: FEBIAC. Subfigure 1b shows the number of new electric car registrations in Belgium by companies (dotted black line) and individuals (solid blue line) from 2012 to 2023. Electric cars registered by a company include both company cars for business purposes and salary or benefit-in-kind cars, i.e., cars registered by company given to employees as part of their remuneration package. Data source: Statbel. Subfigure 1c shows the total number of gas cars (internal combustion engine, ICE, in gray) and that of battery electric cars (EV, in green) in circulation in Belgium, 2022. Data source: FEBIAC and Statbel.



(a) All municipalities (b) Border municipalities

Figure 2: Geographic coverage of treatment and control groups

These figures illustrate the geographic composition of the treatment and control groups. Panel (a) displays all municipalities, with municipalities in Flanders forming the treated group and those in Brussels and Wallonia forming the control group. Panel (b) restricts the sample to municipalities located along the linguistic border between Flanders and Wallonia, which constitute the border-municipality sample.



(a) All municipalities

(b) Border municipalities

Figure 3: Average Electric Vehicle Purchase rate

This figure shows monthly averages of the Electric Vehicle Purchase Rate (%) across municipalities in the Treated (orange) and Control (blue) groups. Shaded areas indicate 95% confidence intervals around the group-specific means. The vertical dashed line marks the introduction of the subsidy on January, 2024 and the phase out on November, 2024.

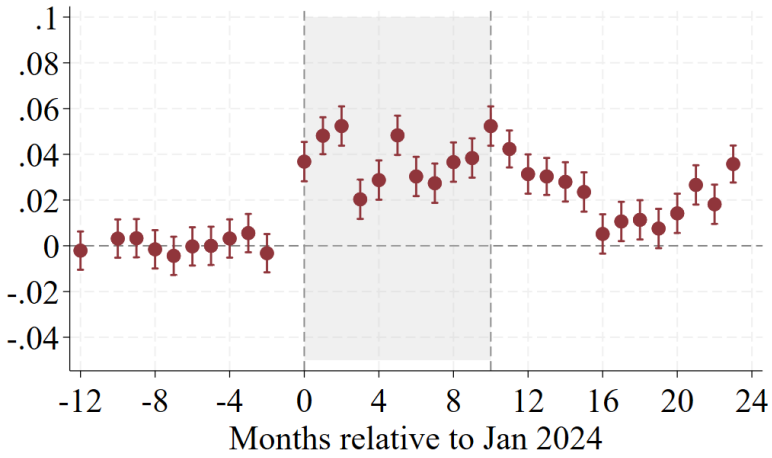
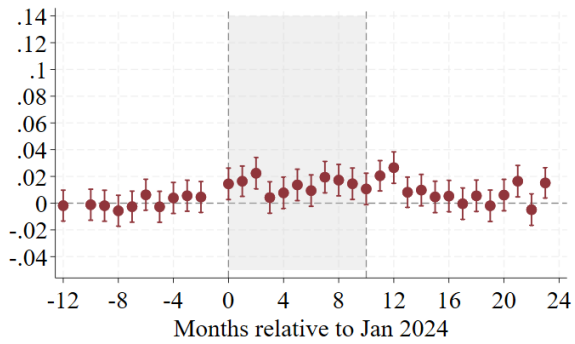
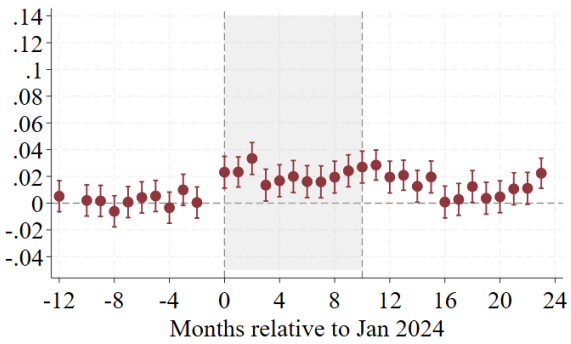


Figure 4: Effect of the subsidy on electric vehicle purchase household level (border municipalities)

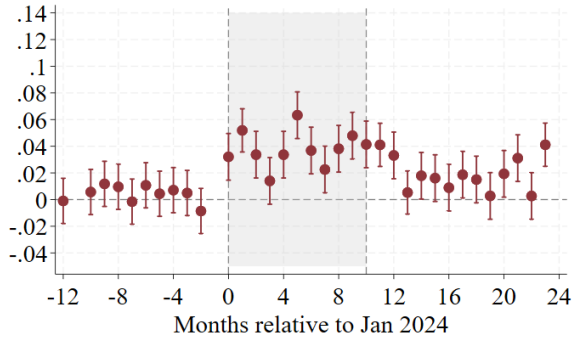
This figure plots event-study (dynamic DiD) coefficients $\hat{\alpha}_j$ from equation 1. Month -1 (December 2023) is omitted and serves as the reference period. Vertical bars show 95% confidence intervals. The subsidy (treatment) is introduced on January 1, 2024 and is phased out on November 23, 2024.



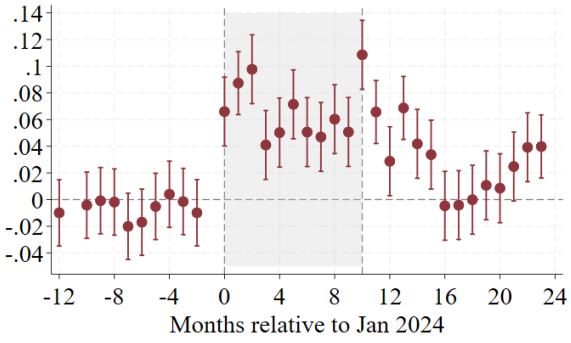
(a) Income group 1 (lowest)



(b) Income group 2



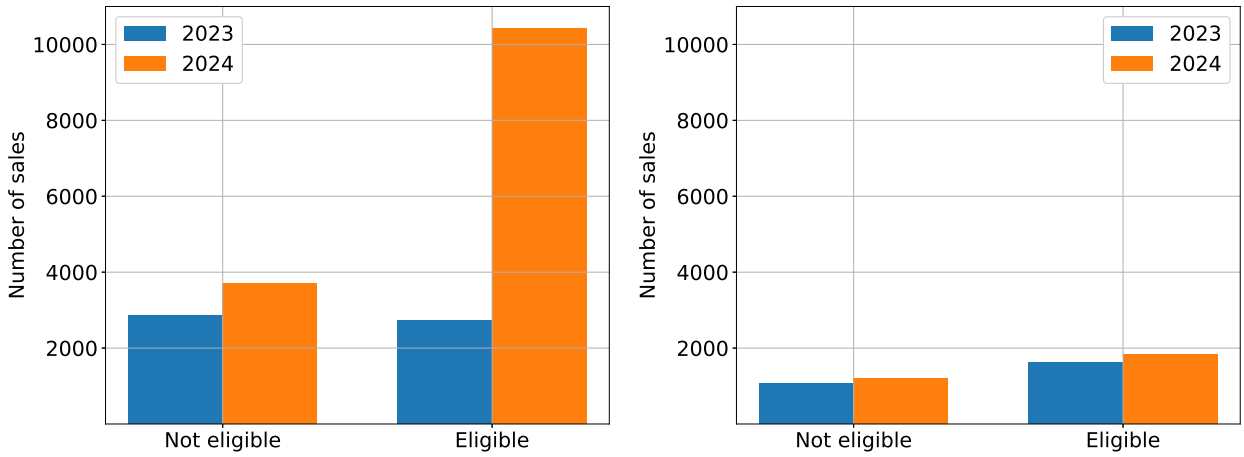
(c) Income group 3



(d) Income group 4 (highest)

Figure 5: Heterogeneous Effects of the Subsidy on EV Adoption by Income Group

This figure reports event-study coefficients $\hat{\alpha}_j$ from equation 1, estimated separately by income group for households residing in border municipalities. Month -1 (December 2023) is the omitted reference period. Vertical bars denote 95% confidence intervals. The subsidy is introduced on January 1, 2024 and phased out on November 23, 2024.



(a) Flanders

(b) Non-Flanders

Figure 6: Sales of electric cars by subsidy eligibility status

The graphs compare sales of cars eligible for the subsidy versus cars not eligible for the subsidy in 2023 and 2024, both in Flanders and in non-Flanders regions. This graph is restricted to cars that belong to the sixteen brands sample from JATO.

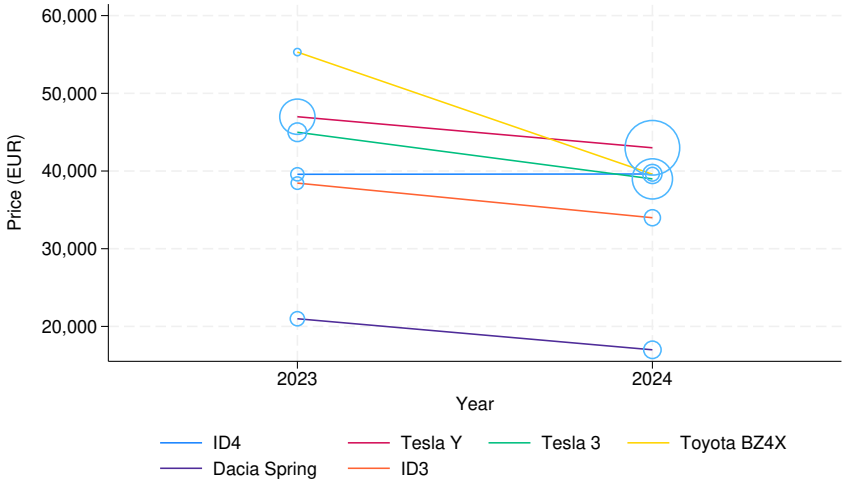
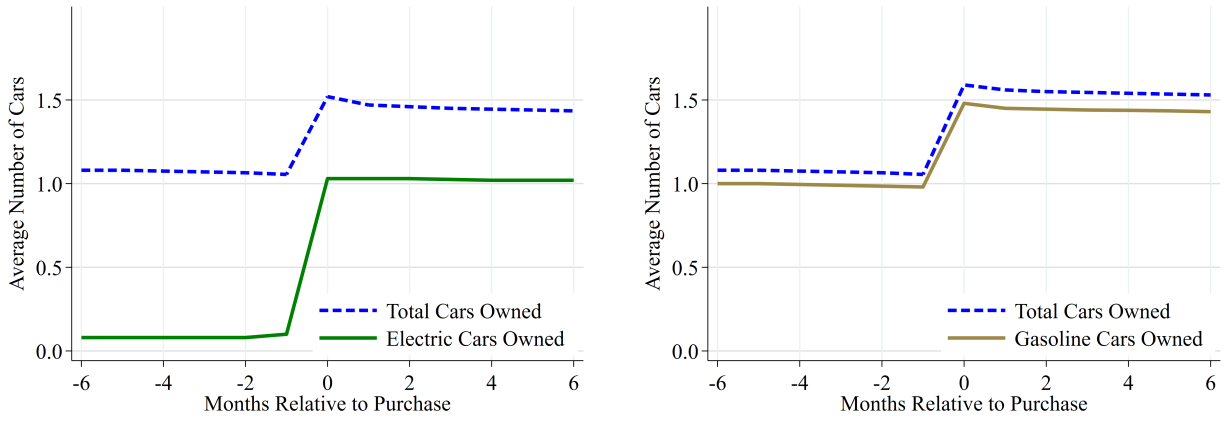


Figure 7: Overview of electric car prices (top 6 models)

This figure shows the price of the cheapest version of each of the top 6 selling models that were sold in 2023 and 2024. The width of the circles reflects the number of sales of each model. Data: JATO, private car sales only.



(a) Electric vehicle purchase

(b) Gasoline vehicle purchase

Figure 8: Households' car ownership around vehicle purchases

Figure 8a plots the average number of cars and electric cars owned by households that purchase an electric vehicle in 2023 - 2024, averaged across all such households at each event month. Figure 8b reports the corresponding averages for households that purchase a gasoline vehicle over the same period.

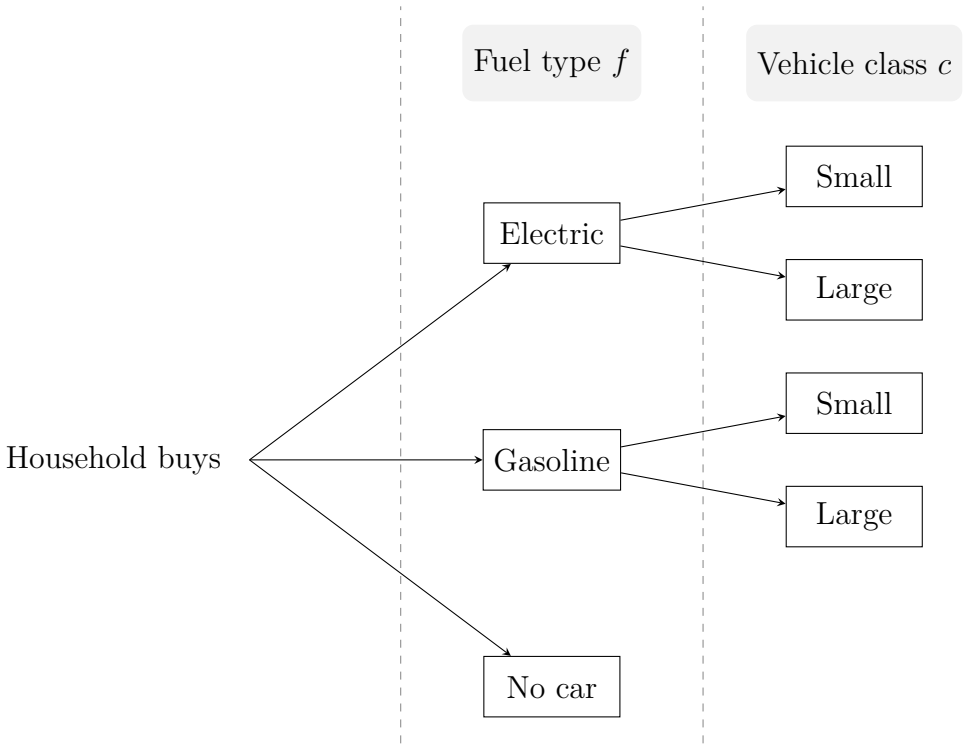
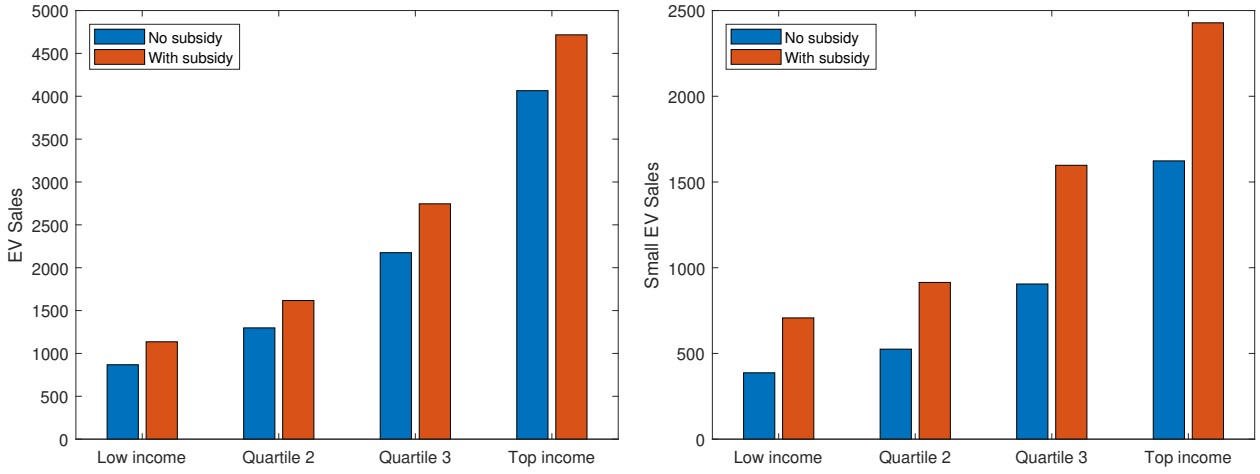


Figure 9: Choice decision tree

This figure shows the options available to the household in the model of section 4.



(a) Total EV sales (big and small cars)

(b) Small EV sales

Figure 10: Impact of the subsidy on EV sales

Figure 10a shows total sales of electric vehicles with and without the subsidy, broken down by income quartiles. Figure 10b focuses on sales of small electric vehicles (with a price below €40,000).

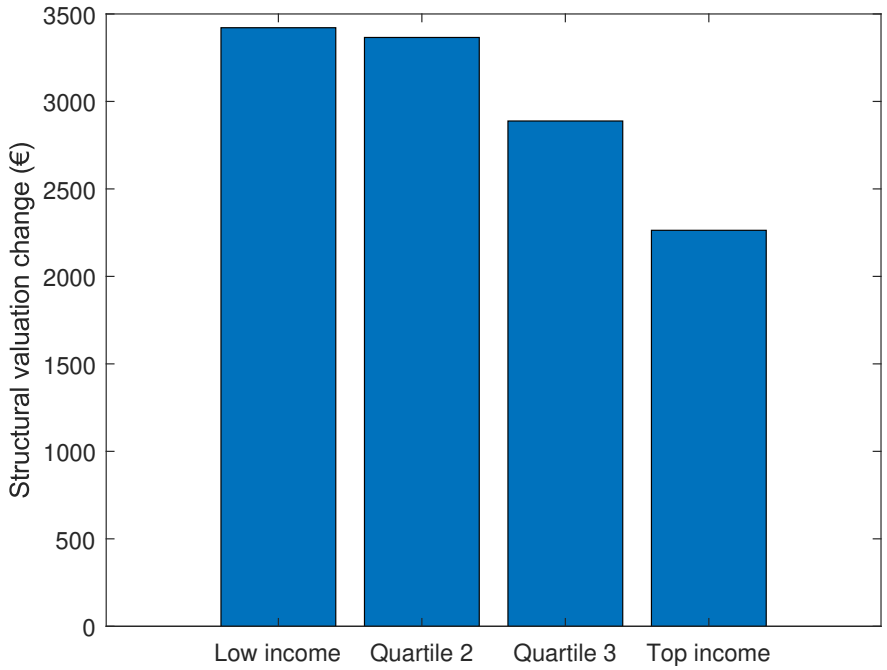


Figure 11: Permanent impact of utility on consumer valuation for EVs

The Figure shows the €equivalent change in preferences of consumers towards EVs after the subsidy.

Table 1: Household Characteristics in Border Municipalities

	Flanders		Other regions	
	Mean	Std. dev.	Mean	Std. dev.
EV purchase rate (%)	0.03	1.64	0.03	1.74
Log household income	10.33	1.78	10.22	1.96
Household income (€)	48,209	33,093	46,535	33,060
Average number of employed members	1.07	0.93	1.01	0.92
Average number of salary cars	0.21	0.50	0.17	0.45
Average number of children	0.52	0.95	0.52	0.93
Average household size	2.36	1.34	2.36	1.34
Average number of higher-educated members	0.59	0.78	0.59	0.77
Average number of homeowners	1.76	1.49	1.67	1.52
Observations	2,645,928		2,410,176	
Households	220,494		200,848	

Notes: This table reports characteristics of households residing along the regional border over the pre-subsidy period (January - December 2023).

Table 2: Household Characteristics by Income Quartile

	Q1 (Lowest)	Q2	Q3	Q4 (Highest)
EV purchase rate (%)	0.02	0.03	0.06	0.09
	(1.29)	(1.86)	(2.36)	(3.05)
Log household income	8.98	10.48	10.87	11.41
	(2.69)	(0.12)	(0.10)	(0.26)
Household income (€)	17,243	35,933	52,920	93,843
	(7,603)	(4,081)	(5,521)	(26,791)
Average number of employed members	0.40	0.85	1.34	1.82
	(0.55)	(0.78)	(0.81)	(0.78)
Average number of salary cars	0.03	0.07	0.18	0.52
	(0.18)	(0.28)	(0.44)	(0.70)
Average number of children	0.33	0.40	0.59	0.75
	(0.84)	(0.86)	(0.95)	(1.00)
Average household size	1.65	2.26	2.62	3.17
	(1.16)	(1.15)	(1.23)	(1.24)
Average number of higher-educated members	0.20	0.37	0.65	1.24
	(0.45)	(0.60)	(0.72)	(0.85)
Average number of homeowners	0.81	1.57	2.03	2.78
	(1.02)	(1.28)	(1.44)	(1.46)
Observations	5,252,988	3,086,508	3,127,260	3,749,316
Households	152,432	90,558	92,039	108,445

Notes: This table reports sample averages and standard deviations (in parentheses) for households residing in municipalities located along the regional border. Statistics pool household - month observations from both regions over the full sample period (2023-2025) and are presented separately by household income quartile. Income quartiles are constructed from midpoint-imputed administrative income brackets and therefore represent relative income groups that do not contain equal numbers of households. EV purchase rate (%) denotes the share of householdmonth observations in which a household purchases an electric vehicle.

Type	Emissions (gCO_2/km)	Market share
No purchase	222	0.886
New small EV	65	0.001
New large EV	120	0.002
New small gas	170	0.106
New large gas	300	0.005

Table 3: Key parameters used for the counterfactual emissions estimates

This table shows the lifecycle GHG intensity of each vehicle considered in our analysis (in gCO_2-equivalent per vehicle-km). It also shows the market share of each option for Flanders in 2023.

Internet Appendix to "Subsidies and Household Technology Adoption: Evidence from the Belgian Auto Market"

A. Additional Figures and Tables

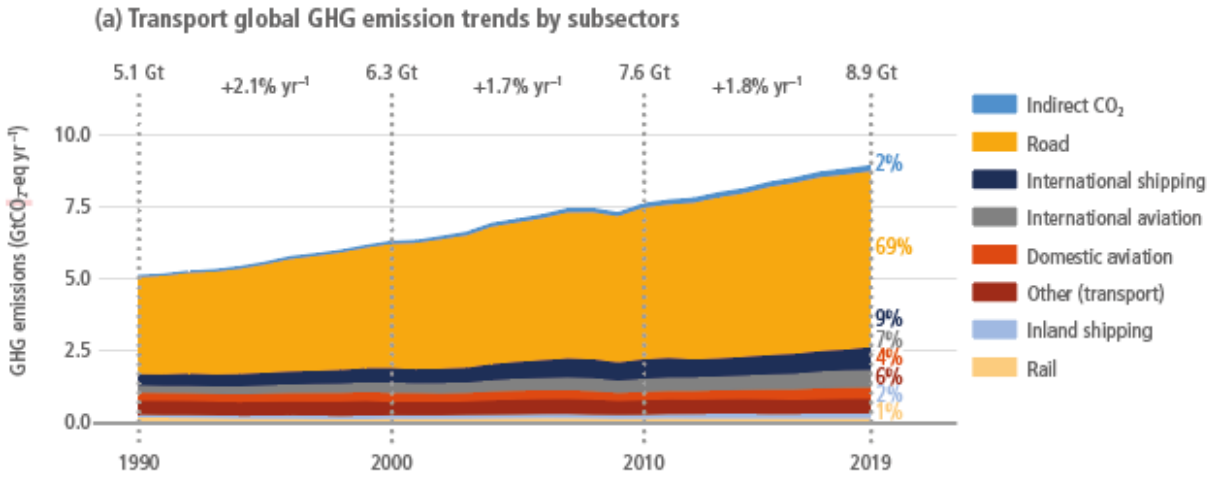


Figure A1: Transport global greenhouse gas emissions by subsector

Notes: Source: IPCC (2022), *Climate Change 2022: Mitigation of Climate Change*, Working Group III, Chapter 2.

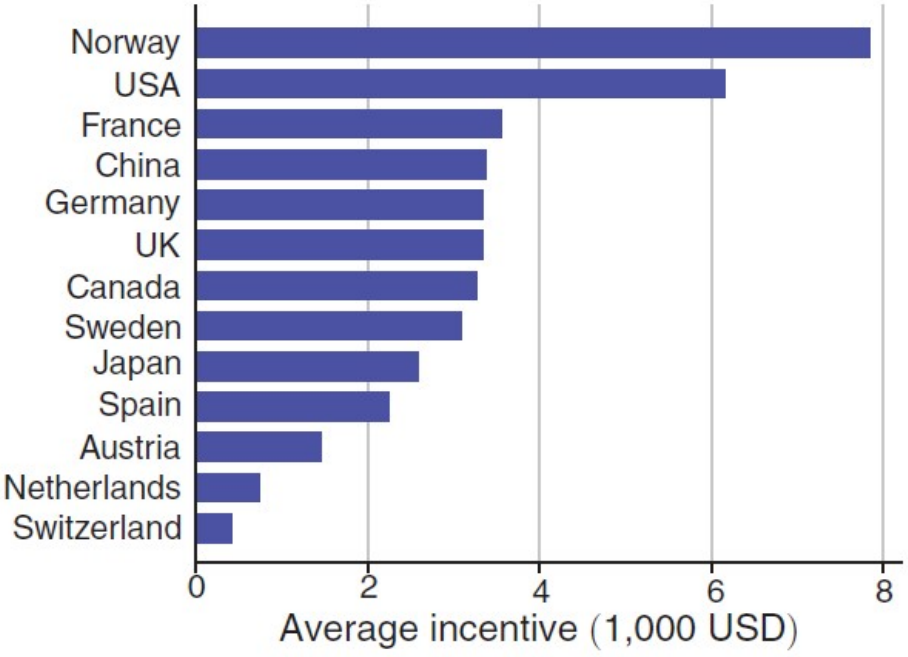


FIGURE 1. AVERAGE FINANCIAL INCENTIVE PER VEHICLE FROM CENTRAL GOVERNMENT, 2013–2020

Figure A2: Average central-government financial incentives per vehicle, 2013–2020

Notes: Source: Barwick et al. (2023).

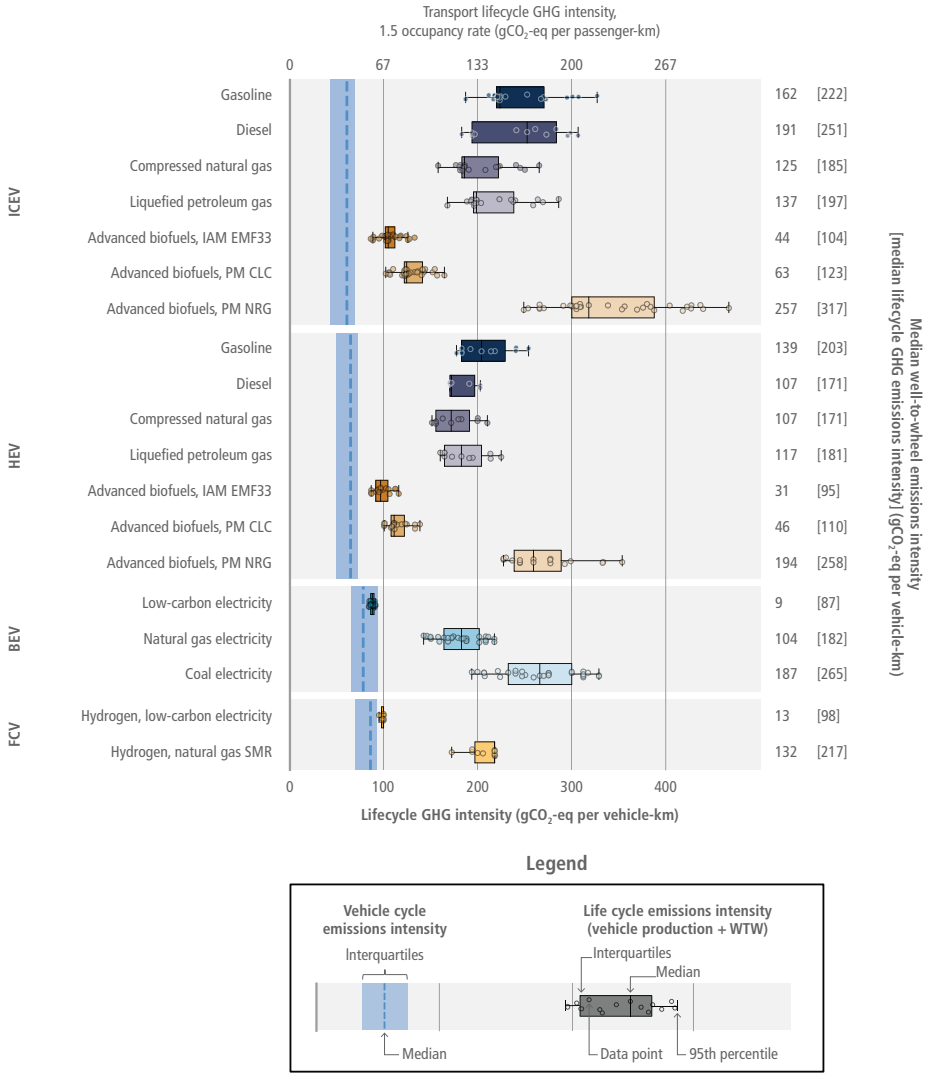


Figure 10.4 | Life cycle greenhouse gas emissions intensities for mid-sized light-duty vehicle and fuel technologies from the literature. The primary x-axis reports units in gCO_2-eq vkm^{-1}, assuming a vehicle life of 180,000 km. The secondary x-axis uses units of gCO_2-eq pkm^{-1}, assuming a 1.5 occupancy rate. The values in the figure rely on the 100-year GWP value embedded in the source data, which may differ slightly from the updated 100-year GWP values from WGI. The shaded area represents the interquartile range for combined vehicle manufacturing and end-of-life phases. The length of the box and whiskers represent the interquartile range of the operation phase for different fuel chains, while their placement on the x-axis represents the absolute lifecycle climate intensity, that is, includes manufacturing and end-of-life phases. Each individual marker indicates a data point. 'Advanced biofuels' refers to the use of second-generation biofuels and their respective conversion and cultivation emission factors. 'IAM EMF33' refers to emissions factors for advanced biofuels derived from simulation results from the integrated assessment models EMF33 scenarios. 'PM' refers to partial models, where 'CLC' is with constant land cover and 'NRG' is with natural regrowth. 'Hydrogen, low-carbon electricity' is produced via electrolysis using low-carbon electricity. 'Hydrogen, natural gas SMR' refers to fuels produced via steam methane reforming of natural gas.

Figure A3: Life-cycle greenhouse gas emissions by vehicle and fuel technology

Notes: Source: IPCC (2022), *Climate Change 2022: Mitigation of Climate Change*, Working Group III, Chapter 2. Battery electric vehicles powered by low-carbon electricity exhibit the lowest life-cycle greenhouse gas emissions.

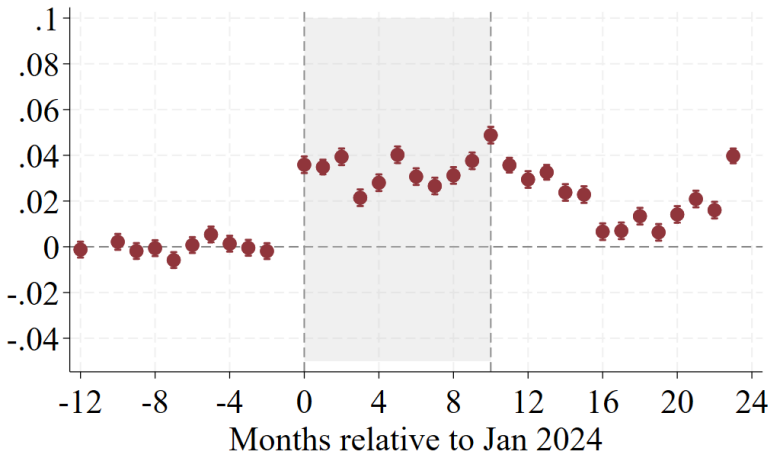
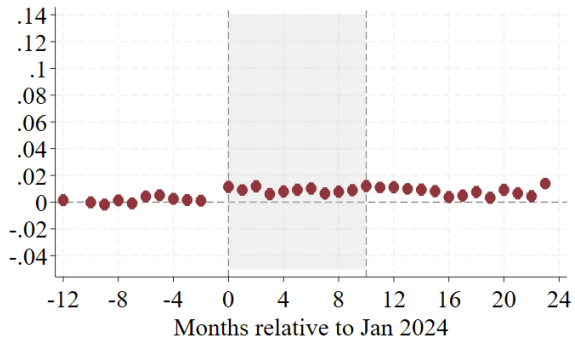
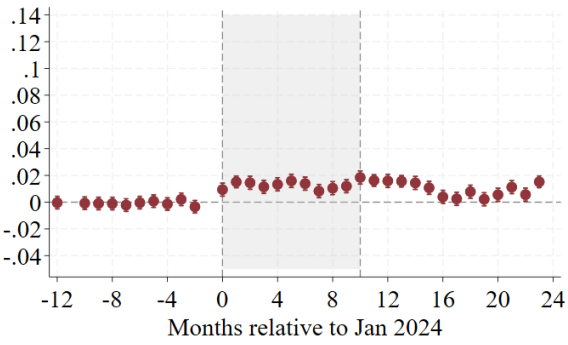


Figure A4: Effect of the subsidy on electric vehicle purchase household level (all municipalities)

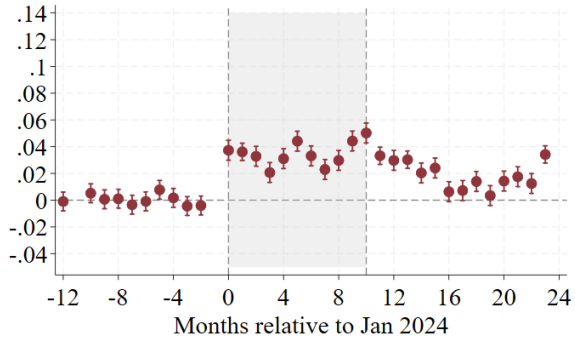
This figure plots event-study (dynamic DiD) coefficients $\hat{\alpha}_j$ from equation 1. Month -1 (December 2023) is omitted and serves as the reference period. Vertical bars show 95% confidence intervals. The subsidy (treatment) is introduced on January 1, 2024 and is phased out on November 23, 2024.



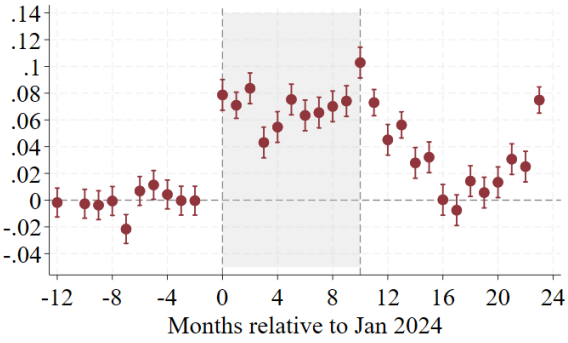
(a) Income quartile 1



(b) Income quartile 2



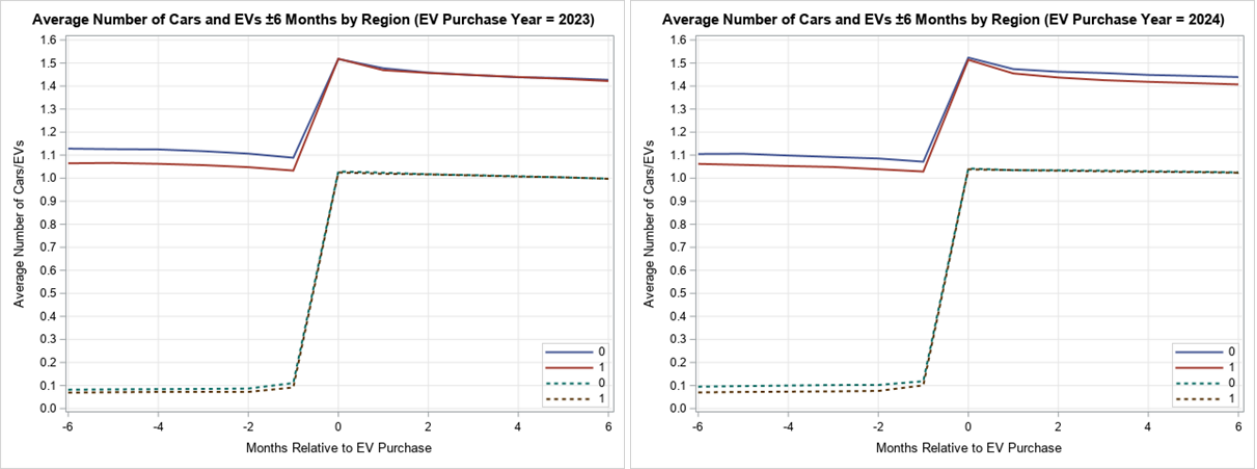
(c) Income quartile 3



(d) Income quartile 4

Figure A5: Effects of the subsidy on Electric Vehicle Purchase Household level (All municipalities)

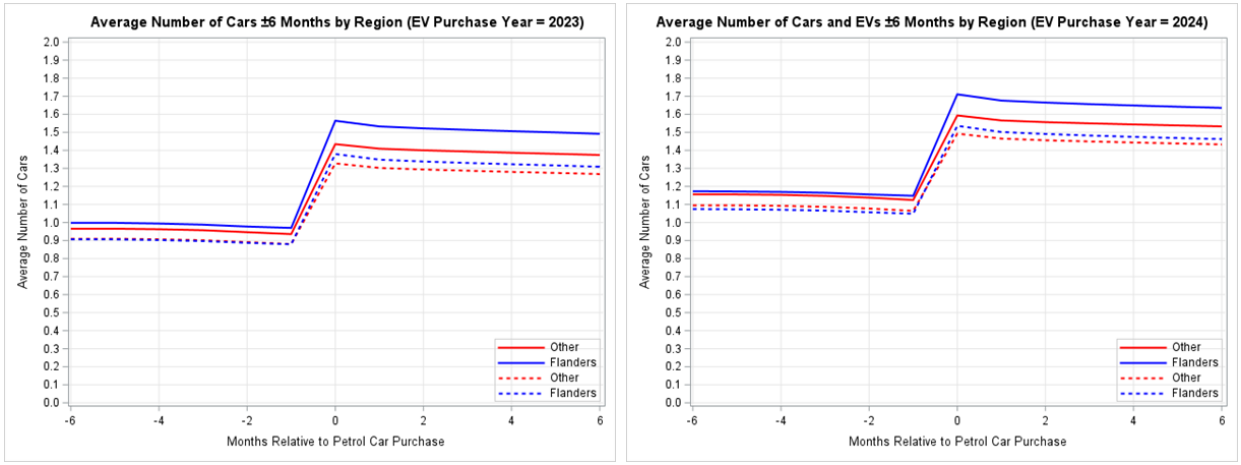
Notes: This figure plots event-study (dynamic DiD) coefficients $\hat{\alpha}_j$ from equation 1 for border municipalities, split by income quartile. Month -1 (December 2023) is omitted and serves as the reference period. Vertical bars show 95% confidence intervals. The subsidy (treatment) is introduced on January 1, 2024 and is phased out on November 23, 2024.



(a) Electric Car Purchase in 2023 (b) Electric Car Purchase in 2024

Figure A6: Households' Average Number of Cars and Electric Cars Owned by Region and by Electric Car Purchase Year

Panel (a) shows the average number of cars (solid lines) and average number of electric cars (dashed lines) owned by households in Flanders (red lines) and households in other regions (blue and green lines) that purchased an electric car in 2023. Panel (b) shows the corresponding averages for households that purchased an electric car in 2024.



(a) Gasoline Car Purchase in 2023 (b) Gasoline Car Purchase in 2024

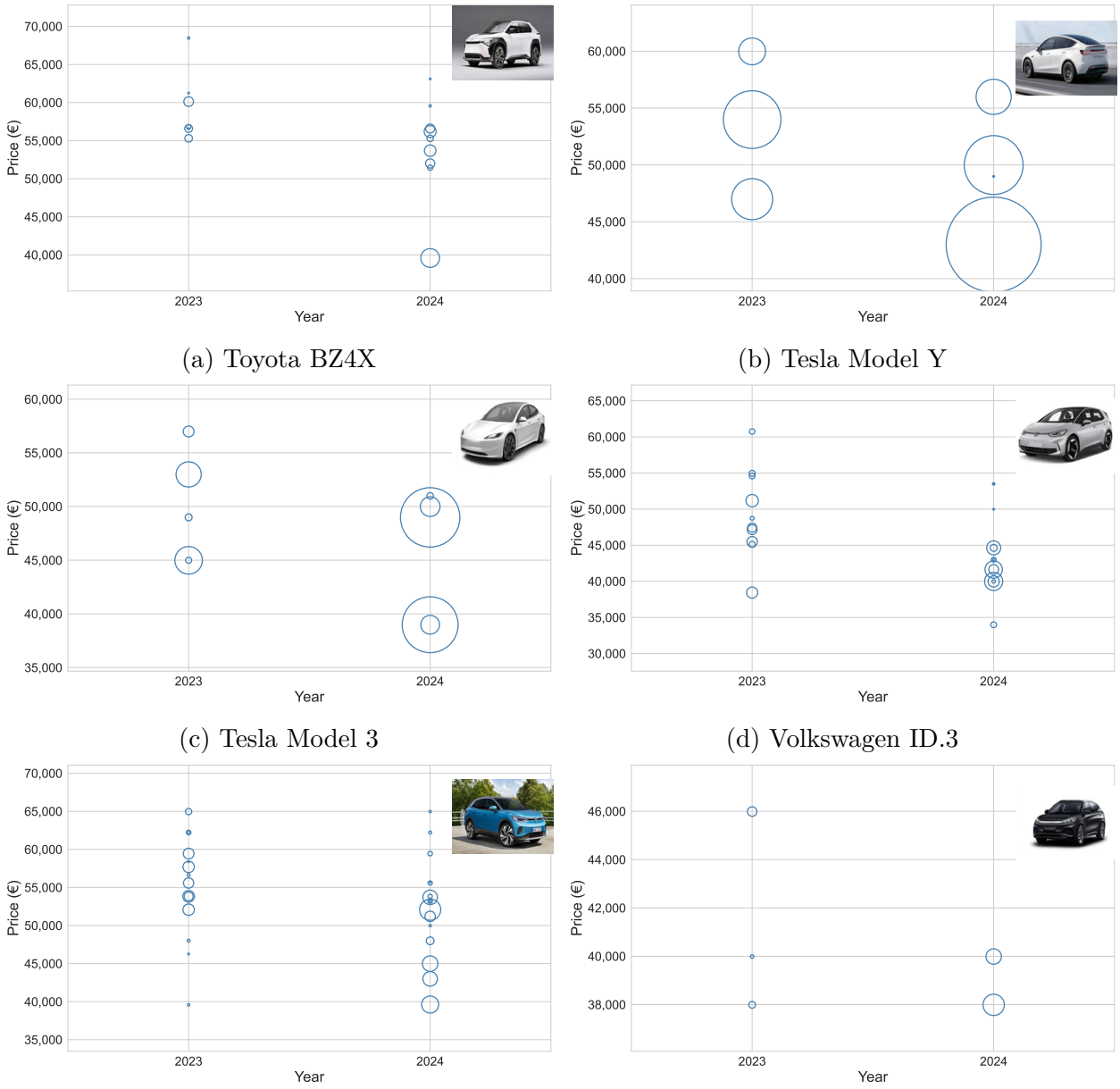
Figure A7: Households' Average Number of Cars and Gasoline Cars Owned by Region and by Gasoline Car Purchase Year

Panel (a) shows the average number of cars (solid lines) and average number of gasoline cars (dashed lines) owned by households in Flanders (blue lines) and households in other regions (red lines) that purchased a gasoline car in 2023. Panel (b) shows the corresponding averages for households that purchased a gasoline car in 2024.

Table A1: Car registrations by price category, make, and region

		Flanders			Non-Flanders		
Price range	Brand	2022	2023	2024	2022	2023	2024
0–30k	Tesla	0	0	0	0	0	0
	Volvo	0	0	0	0	0	0
	Others	152	160	639	83	187	83
30–40k	Tesla	0	0	0	0	0	0
	Volvo	0	0	0	0	0	0
	Others	270	80	108	132	42	26
40–50k	Tesla	0	231	1,756	0	237	561
	Volvo	0	0	717	0	0	121
	Others	577	673	1,839	147	213	168
50–60k	Tesla	80	0	0	73	0	0
	Volvo	169	379	311	54	79	58
	Others	403	635	403	89	220	67
60–70k	Tesla	311	1,064	3,654	219	596	636
	Volvo	0	0	0	0	0	0
	Others	206	612	1,110	59	152	232
>70k	Tesla	10	45	12	0	10	0
	Volvo	0	0	0	0	0	0
	Others	362	358	575	61	71	93

Notes: This table reports the number of car registrations observed in Statbel for which a reliable match with JATO car prices is available.



(a) Toyota BZ4X

(b) Tesla Model Y

(c) Tesla Model 3

(d) Volkswagen ID.3

(e) Volkswagen ID.4

(f) BYD Atto 3

Figure A8: Distribution of version prices for the top 6 models in 2023 and 2024, weighted by sales

Notes: This figure shows the prices of different car versions for the top 7 selling models in 2023 and 2024. When different prices are available within a car model-version, we take the lowest value. The width of the circles reflects the number of sales of each model. Data: JATO, private car sales only.

Table A2: Event-Study Estimates of Household Car Ownership Around EV Purchase (Part A)

Variable	β
Constant	1.43^{***}
Months to Purchase $= -6$	-0.30^{***}
Months to Purchase $= -5$	-0.30^{***}
Months to Purchase $= -4$	-0.30^{***}
Months to Purchase $= -3$	-0.31^{***}
Months to Purchase $= -2$	-0.32^{***}
Months to Purchase $= -1$	-0.34^{***}
Month of Purchase ($t = 0$)	0.09^{***}
Months to Purchase $= +1$	0.05^{**}
Months to Purchase $= +2$	0.03
Months to Purchase $= +3$	0.02
Months to Purchase $= +4$	0.01
Months to Purchase $= +5$	0.01
Flanders	-0.01
Months to Purchase $= -6 \times$ Flanders	-0.06^{*}
Months to Purchase $= -5 \times$ Flanders	-0.05^{*}
Months to Purchase $= -4 \times$ Flanders	-0.06^{*}
Months to Purchase $= -3 \times$ Flanders	-0.06^{*}
Months to Purchase $= -2 \times$ Flanders	-0.05^{*}
Months to Purchase $= -1 \times$ Flanders	-0.05^{*}
Month of Purchase ($t = 0$) $\times$ Flanders	0.01
Months to Purchase $= +1 \times$ Flanders	0.00
Months to Purchase $= +2 \times$ Flanders	0.00
Months to Purchase $= +3 \times$ Flanders	0.01
Months to Purchase $= +4 \times$ Flanders	0.01
Months to Purchase $= +5 \times$ Flanders	0.00
Year Purchase $= 2024$	0.01
Months to Purchase $= -6 \times$ Year Purchase $= 2024$	-0.04
Months to Purchase $= -5 \times$ Year Purchase $= 2024$	-0.03
Months to Purchase $= -4 \times$ Year Purchase $= 2024$	-0.04
Months to Purchase $= -3 \times$ Year Purchase $= 2024$	-0.04
Months to Purchase $= -2 \times$ Year Purchase $= 2024$	-0.03
Months to Purchase $= -1 \times$ Year Purchase $= 2024$	-0.03

Notes: See Table A3 for remaining interaction terms. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table A3: Event-Study Estimates of Household Car Ownership Around EV Purchase (Part B)

Variable	β
Month of Purchase ($t = 0$) $\times$ Year Purchase = 2024	-0.01
Months to Purchase = $+1$ $\times$ Year Purchase = 2024	-0.02
Months to Purchase = $+2$ $\times$ Year Purchase = 2024	-0.01
Months to Purchase = $+3$ $\times$ Year Purchase = 2024	0.00
Months to Purchase = $+4$ $\times$ Year Purchase = 2024	0.00
Months to Purchase = $+5$ $\times$ Year Purchase = 2024	0.00
Flanders $\times$ Year Purchase = 2024	-0.03
Months to Purchase = -6 $\times$ Flanders $\times$ Year Purchase = 2024	0.05
Months to Purchase = -5 $\times$ Flanders $\times$ Year Purchase = 2024	0.04
Months to Purchase = -4 $\times$ Flanders $\times$ Year Purchase = 2024	0.04
Months to Purchase = -3 $\times$ Flanders $\times$ Year Purchase = 2024	0.04
Months to Purchase = -2 $\times$ Flanders $\times$ Year Purchase = 2024	0.04
Months to Purchase = -1 $\times$ Flanders $\times$ Year Purchase = 2024	0.04
Month of Purchase ($t = 0$) $\times$ Flanders $\times$ Year Purchase = 2024	0.02
Months to Purchase = $+1$ $\times$ Flanders $\times$ Year Purchase = 2024	0.02
Months to Purchase = $+2$ $\times$ Flanders $\times$ Year Purchase = 2024	0.00
Months to Purchase = $+3$ $\times$ Flanders $\times$ Year Purchase = 2024	0.00
Months to Purchase = $+4$ $\times$ Flanders $\times$ Year Purchase = 2024	0.00
Months to Purchase = $+5$ $\times$ Flanders $\times$ Year Purchase = 2024	0.00

Notes: The table reports coefficient estimates from an event-study regression of household car ownership around an electric vehicle (EV) purchase. Event time is measured in months relative to the EV purchase date ($t = 0$). The omitted category is the long-run post-purchase period. Flanders is an indicator for households located in Flanders. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

B. Data Appendix

B.1. Merging Car Prices

To merge car prices with the administrative data, we proceed as follows.

We first extract electric vehicles from JATO by filtering out version names that include keywords such as “electric”, “e-tech”, “BEV”... and excluding observations with keywords such as “hybrid”, “plug-in”, “MHEV”, “PHEV”.... In the next step, we filter electric models specific to the brand. For instance, all Audi which have “E-Tron” in their version are selected, as well as all “Zoe” from Renault.

Next, we need to merge these electric car prices with electric cars observed in Statbel. We only match cars that belong to the sixteen brands in JATO. There are 30,524 new electric vehicles observed in Statbel from 2022 to 2024. From this, 22,670 are matched with a car price (or several cars) in JATO, that is to say, 74% of Statbel vehicles are matched.

We first make an exact match on make, year and model. It means an “Audi E-tron Q45” sold in 2022 cannot be matched with an “Audi E-tron Q40”, or a Tesla, or any car sold in 2023. We assume that the year of first registration in Statbel is the same as the year of the sales in JATO. A model can have a lot of different versions, thus, to match versions, the following method is used : if the exact version of the car from Statbel is found in JATO, the price is associated. In our example, if JATO contains a car sold in 2022 of make “Audi”, model “Q45” and version “E-tron”, its price is associated. If there is no exact match, but the version from Statbel is still contained in one or several versions in JATO, the weighted average price by sales is computed. For instance, here, if there are versions such as “E-tron BEV 82kwh 45 advanced auto 4wd” and " E-tron BEV 82kwh 45 attraction auto 4wd" with make "Audi", model "Q45" and year 2022, the weighted average price by sales of those cars is matched. Finally, if no version in JATO contains the version from Statbel, the version with the highest number of words in common is matched. The "BMW i4 eDrive35" sold in 2022 could be matched with a "BMW I4 edrive40" also sold in 2022 in that case.