

Identifying circumstances in which the introduction of distance-based, cordon-based, and congestion-free lane road user charge regimes garner support

David A Hensher^{a, *}

Edward Wei^a

Camila Balbontin^{a, b, c, d}

John D. Nelson

^a Institute of Transport and Logistics Studies (ITLS)

The University of Sydney Business School

Sydney NSW Australia 2006

David.Hensher@Sydney.edu.au

Edward.Wei@Sydney.edu.au

Camila.Balbontin@Sydney.edu.au

J.Nelson@Sydney.edu.au

^b Department of Transport Engineering and Logistics, Faculty of Engineering, Pontificia Universidad Católica de Chile (PUC)

^c Centre for Sustainable Urban Development, Santiago, Chile

^d Instituto de Sistemas Complejos de Ingeniería, Santiago, Chile

[*Corresponding author](#)

1 September 2025

Abstract

The most challenging transport reform has always been associated with re-pricing of car use. Despite the growing levels of congestion on our roads, there is general reluctance to support a package of pricing reforms designed to make each and every car user potentially better off financially and/or in saving time. There exist a number of systemwide charging reforms such as the Oregon kilometre-based charging regime, but they are in the main opt-in models, which offer an appealing way for politicians to support the ideals of giving everyone a choice. The cordon-based congestion charging schemes in London, Milan, Stockholm, Gothenburg, New York, and Singapore, while applying to all users who enter a specific location, are limited to one location as is the idea of a congestion-free priced lane. This paper focuses on re-pricing options (with varying charges) to identify how residents are likely to respond to peak period distance-based charging throughout an entire city, cordon-based charges in a defined geographical area, and congestion-free priced lanes on major roads. A series of road pricing initiatives were offered to over 4,000 individuals in seven countries, seeking advice on whether a particular initiative is likely to have a positive or negative impact (or none at all) on how they travel, revealing support or otherwise for a specific re-pricing regime. For each road pricing initiative, we ran a generalised ordered logit model to identify what contextual variables influence the probability of an initiative being associated with a positive impact, a negative impact, or no impact. We are especially interested in understanding how prior “windows of change” associated with lifestyle, mobility, work, commuting, and environmental preferences condition support or otherwise for each road pricing reform initiative. The findings provide suggestions on the extent to which each of the eight

initiatives assessed can deliver support or otherwise for road pricing reforms from individuals whose recent past is associated with one or more of the 70 windows of change investigated.

Keywords: Road pricing reform, distance-based charging, cordon-based charges, congested free paid lanes, peak period, user benefit, 7 country survey, windows of change influences.

Declaration of Interest: There is no conflict.

Credit authorship contribution statement

David Hensher: Conceptualisation, Investigation, Methodology, Formal analysis, Writing original draft, Writing – review & editing, Project administration. **Edward Wei:** Conceptualisation, Investigation, Writing original draft, Writing - Review & Editing. **Camila Balbontin:** Formal analysis, Writing - Review & Editing. **John Nelson:** Conceptualisation, Investigation, Writing original draft, Writing – review & editing, Project administration.

Acknowledgement: This research is part of iMOVE Cooperative Research Centre (CRC) research project 3-034 titled “Establishing a Framework of Support to Scale in Mobility as a Service” with Transport and Main Roads, Queensland, and research project 3-039 titled “Behavioural Change for Sustainable Transport” with Transport and Main Roads, Queensland, ITS Australia, and The Department of Infrastructure, Transport, Regional Development and Communications, Sport and the Arts. The findings reported are those of the authors and are not the positions of our industry and government partners; but approval to present these findings is appreciated. We thank members of the ITLS team: Corinne Mulley, Thiranjaya Kandanaarachchi, Chinh Ho, and Wen Liu. The third author gratefully acknowledges financial support from ANID/FONDAP 1523A0004 and ANID PIA/PUENTE AFB230002.

Introduction

There is an extensive literature on promoting ways to reform road usage for passenger cars, especially in the context of containing traffic congestion, be it by pricing or non-pricing initiatives. For over 70 years, the debate has ebbed and flowed as to how we could tame traffic congestion through non-pricing mechanisms; and despite some successes, they are typically limited to a few geographical jurisdictions and often relocate the problem to adjacent areas. The mere suggestion that the only way to really make a difference is through a reformed road pricing model is typically viewed with both applause and rejection, the latter primarily by politicians and bureaucrats under instruction from their political masters. The rare exceptions have been cordon-based congestion charging in Central London, Central Stockholm, Gothenburg, downtown Milan, Singapore, and recently Manhattan in New York¹; as well as a limited opt-in kilometre-based charging in Oregon, and the HOT (High-Occupancy Toll) lanes in Southern California².

¹ <https://www.youtube.com/watch?v=Mnln3R9RBh4>. Since implementation in January 2025, we have seen 2.8 million fewer vehicles or 10% of cars (60,000 per day) entering Manhattan’s CBD, with faster travel speeds (7.8% in weekday peak times and 10.2% weekends), and shorter river crossing times. Some drivers are moving travel to early and late of day periods to avoid the peak charge.

² New Zealand is moving slowly to a distance-based charging scheme with removal of fuel excise. This enables capture of both battery and petrol/diesel cycles in hybrid vehicles which has become a challenge with their popularity over pure electric cars. In 2015, there were 12,000 hybrid cars, and in 2025 there are over 350,000. See <https://www.rnz.co.nz/news/political/569149/road-user-charges-for-all-vehicles-move-a-step-closer>. Law changes the government is progressing include:

- Removing the requirement to carry or display RUC licences, allowing for digital records instead

What we have yet to see is an initiative that is metropolitan-wide, that applies to all motorists, and that recognises that all motorists could be better off with real travel time savings that can benefit individuals and the network as a whole, especially in peak periods. The interest in this paper is on a distance-based charge during peak periods and contrasting it with cordon-based charges in a defined geographical area, and congestion-free priced lanes on major roads.

The paper is structured as follows. A literature review identifies the history of efforts, conceptually and in practice, to introduce road pricing reforms, followed by a summary of the empirical context for the seven countries included in this study (Australia, New Zealand, UK, Finland, Sweden, Singapore and USA), where eight road pricing initiatives were explored. We then introduce the generalised ordered logit model to estimate a series of models for each initiative where the dependent variable is an ordered response (negative impact, no impact, positive impact), extending the standard ordered logit model to allow for latent heterogeneity. A descriptive profile of the data is followed by the estimated models and the direct mean elasticities for each explanatory variable. We compare the evidence across all eight initiatives and conclude with the main findings.

Literature Review

An Overview of approaches to Road Pricing and Congestion

The field of road pricing is well established historically in terms of its theoretical foundations. The history and development of road pricing have been widely reviewed by researchers (e.g., Button 2020; Anas & Lindsey 2011). Button (2020) provided a review of the history of road pricing in economics from the initial idea proposed by Pigou in 1920, to further contributions of many economists, including Buchanan, Vickrey, Solow, Friedman, Walters and many others. In practice, a seminal work by Smeed (1964) is commonly considered the first road pricing proposal to target road congestion. Glaister (2018) gave a benchmark review on road pricing development 50 years after the Smeed Report was published, covering practical road pricing schemes that involve users paying a unit price based on road usage of various forms, such as by distance, location or time of day (TOD). Anas and Lindsey (2011) reviewed both the theory and practice of road pricing. Stanley and Hensher (2011) demonstrate the broad extent of under-recovery of costs, with congestion being a dominant underpriced externality.

In simple terms, road pricing is about allocating transportation resources covering all road infrastructure and mobility resources to road users and internalising external costs associated with using road transportation. The external costs include many types of costs, with the majority caused by road congestion. Road pricing schemes aim to internalise targeted costs with equity and efficiency, which is also the principle of public policies in transport underpinned by economic theories and practices (Anas & Lindsey 2011; Ison 2018; Falcochio & Levinson 2015). The schemes can be revenue neutral: besides re-investing in infrastructure, any collected road

-
- Enabling the use of a broader range of electronic RUC devices, including those already built into many modern vehicles
 - Supporting flexible payment models such as post-pay and monthly billing
 - Separating NZTA's roles as both RUC regulator and retailer to foster fairer competition
 - Allowing bundling of other road charges like tolls and time of used based pricing into a single, easy payment.

pricing revenues can be returned to the public and road users (Hensher & Li 2013; Hensher et al. 2013). Road pricing schemes can take many forms, with distance-based, time-based, area-based, or a combination of these (Anas & Lindsey 2011).

The main driver for the development of road pricing is to mitigate congestion. Many factors can cause congestion. Besides the increase of travel demand and vehicle numbers due to ongoing population and area growth, there are many other reasons for congestion, such as peak hour traffic and concentration of activities, operational and physical bottlenecks, weather, events, work zones, and other causes (Falcocchio & Levinson 2015). Traffic volume, costs of car travel, road capacity improvement, and fuel prices also directly influence travel time and the incidence of induced traffic. Goodwin (1996) provided a discussion of some related elasticities of these factors. Mitigating and transferring road congestion requires careful planning and strategies in all related infrastructure and transport modes. For example, reducing car trips and freight pressure may be accompanied by improved public transport and rail freight capacities to redirect road traffic to other alternatives (Hensher 1998).

Road pricing is not the only way to alleviate congestion. There are many other ways to reduce car usage, such as through soft intervention measures in Transport Demand Management (TDM), classically defined by Meyer (1999) as an 'action or set of actions aimed at influencing people's travel behaviour in such a way that alternative mobility options are presented and/or congestion is reduced' (p 576). and many soft interventions have been proven to be effective in reducing car use to some extent (e.g., Cleland et al. 2023). Ison (2018) provides detailed classifications of measures targeting congestion, split between the demand and supply sides. Whilst the supply-side measures aim to increase infrastructure capacity, the demand-side measures focus on reducing car use, including through land use design and restrictions, communications, traveller information, economic measures, and administrative measures. Road pricing is among the main economic measures. Cheng et al. (2024) discussed the effectiveness of eight types of interventions in reducing congestion, including road user charging, fuel price/tax, vehicle restrictions, high occupancy vehicle (HOV) lanes, licence plate lottery, parking restrictions, reward/incentives, and soft behavioural measures. Based on the current evidence from empirical road pricing schemes implemented in London, Stockholm, Singapore, and other locations, they concluded that road pricing schemes are effective in reducing congestion in all implemented schemes for the targeted areas at the time of day. This cannot be said for some other interventions; for example, people can have strategies in dealing with the licence plate lottery. With parking restrictions, congestion can even increase with more circulating drivers searching for parking.

Generally, implementing a road pricing scheme involves *designing it to be economically attractive and sound, and gaining public acceptance* to make it feasible and appealing for implementation. Often, a road pricing scheme fails at public acceptability (Anas & Lindsey 2011; Ison 2018). Designing a road pricing scheme requires calculating related costs and pricing them accordingly. Policymakers may focus on different costs or apply a different formula in calculating costs. As a result, the proposed schemes can vary greatly. Some of the standard cost components include the additional travel time, fuel consumption and other costs due to congestion, accidents, infrastructure, and emission and pollution (Bilbao-Ubillos 2008). Other costs, such as the loss of productivity and business costs due to congestion, are often neglected. In reality, the congestion cost for all industry sectors can be enormous. For example, Torrey (2017) provided an estimation of annual congestion costs to the US freight industry. The lost productivity is equivalent to about a quarter of a million commercial truck drivers sitting idle for an entire working year, or an

additional \$49.6 billion in costs. Other congestion-related costs, such as health-related costs, can also be extensive (Hosford et al. 2021). Overall, depending on the purpose of a specific road pricing scheme, the inclusion, calculation, and pricing of road use and congestion-related costs can be quite different.

Once costs are calculated and priced, the options of road pricing schemes can be decided. Ison (2018) summarised the following options, including 1) congestion metering; 2) time-based charging; 3) distance-based charging; 4) point/cordon-based charging; and 5) other forms such as supplementary licences, entry permits and area licences. Besides these options, researchers have been developing novel options for road pricing schemes. Kockelman and Kalmanje (2005) proposed credit-based congestion pricing (CBCP), which is a revenue-neutral policy where an “allowance”, a form of road toll based on negative externalities associated with congestion, is used for frequent long-distance and peak-period drivers to subsidise the “average” drivers. Parry and Small (2005) demonstrate that economic welfare gains are actually higher with a vehicle mile tax (VMT) than with optimal fuel charging, presumably because external costs are more closely driven by distance than by fuel use but also because the elasticity of VMT with respect to fuel cost is quite small, making VMT a more attractive target than fuel for a Ramsey type revenue raising tax. Bliemer et al. (2024) proposed a novel road pricing approach based on a mobility consumption proposition covering both travel distance and travel time. Using an analogy of power consumption, they proposed a “mobility-based” charging method using a vehicle-specific unit charge formula, which embeds both the time and distance components. Jakob and Menendez (2021) proposed a combined parking and road pricing approach with parking (P) and road usage (R) components. Beck et al. (2011) tested variable emission charges for different energy consumption vehicles in designing a road pricing scheme. Hensher and Mulley (2014) proposed combining distance-based charges with discounted vehicle registration.

Country-Specific Road Pricing Schemes

Combined area and time-based road charging is the main form of the limited cases of real-world road pricing schemes implemented in Singapore, London, Stockholm, Gothenburg and other places. Besides these forms, the High Occupancy Toll (HOT) lanes are applied in some areas in the USA.

Singapore has been implementing cordon and expressway pricing by time of day (TOD) and vehicle class since 1998, known as electronic road pricing (ERP). Under ERP, drivers pay to be able to drive within the “Restricted Zone” during a limited time of the day (i.e., between 7:30 to 10 am and 12 to 8 pm in the CBD, and between 7:30 to 9:30 am on the expressway). Researchers have discussed and reviewed the effectiveness and impact of this scheme (e.g., Phang & Toh 2003; Olszewski & Xie 2005; Santos 2005; Falcochio & Levinson 2015; Gärling & Friman 2018; Hosford et al. 2021; Koh & Chin 2022). Overall, this pricing scheme is effective in reducing traffic volume and maintaining the desired speed targets of 45–65 km/h on expressways and 20–25 km/h on arterials. The revenue is returned to some drivers through rebates, and investments from the revenue pool are made to improve transit and road infrastructure (Falcochio & Levinson 2015).

London has applied cordon-based pricing in central London (known as the “Congestion Charge”) since 2003. Over the years, some details of the rules and rates have been adjusted. The current charge is £15 per day for driving within the zone between 7:00 am and 6:00 pm, Monday to Friday, and 12:00 pm to 6:00 pm on weekends. The scheme and its impact have been discussed and reviewed by researchers revealing over 20% reduction in trips over the years within the cordon

area, with revenues used to improve transit and other forms of transportation (e.g., Santos & Shaffer 2004; Santos 2005; Leape 2006; Anas & Lindsey 2011; Croci 2016; Ison 2018; Hosford et al. 2021).

In Stockholm and Gothenburg in Sweden, cordon and time-based road pricing schemes have been implemented since 2006 and 2013, respectively. The charge rate of entering the Inner City varies across the day, with the highest level of 35 SEK from 7:00 am to 8:29 am and from 16:00 to 17:29 on weekdays. The effects and other aspects of the road pricing schemes in the two locations have been reviewed by various authors, with over 20% of traffic reduction in the cordon area and about 15% reduction in emissions reported (Nilsson et al. 2016; Croci 2016; Börjesson & Kristoffersson 2018; Hosford et al. 2021). Net revenues are all used to invest in transit and other transportation infrastructure.

There are several other EU cities, including Milan (EcoPass), Oslo (congestion charge), and Geneva and London (Low Emission Zone), that have similar forms of road pricing schemes, targeting primarily congestion and emission costs and with positive impacts achieved (Croci 2016; Baranzini et al. 2021; Hosford et al. 2021). In the USA, the primary focus of road pricing is different, and the main form is distance and vehicle occupancy-based. These schemes apply variable pricing on lanes. A distance-based road pricing applies where High Occupancy Toll (HOT) lanes only allow low-occupancy vehicles by charging a variable rate to guarantee free flow, while permitting High Occupancy Vehicles (HOVs) to use the lane free of charge. The HOT lanes have been implemented in different parts of the USA, such as Los Angeles, San Diego, Miami, Minneapolis, Seattle, and Salt Lake City (e.g., Schweitzer & Taylor 2008; Yang et al. 2016). Cordon-based road pricing has been evaluated in recent years to analyse the feasibility of implementing it in US cities (Holguin-Veras et al. 2016; Simeone & Thornton 2023). In January 2025, a cordon-based road pricing scheme was implemented in Manhattan, New York City, and the scheme has been showing a positive impact in reducing congestion effectively based on early evidence (Cook et al. 2025).

Road pricing schemes and ideas have been tested for other countries and local areas, including Canada (Washbrook et al. 2006); United Arab Emirates (Abulibdeh 2018); New Zealand (MRCagency 2018); Israel (Cohen-Blanksshtain et al.) and Australia (e.g., Stanley and Hensher 2011; Beck et al. 2011; Hensher et al. 2013; Hensher & Mulley 2014; Sen et al. 2019; Sen et al. 2021). Road pricing is critically important for road usage reform, especially in the era of fast development in sustainable energy and electric vehicles, where fuel taxes become an increasingly lesser source to support transportation; however, the main obstacle to a wider implementation of road pricing schemes lies in the poor public acceptability, hence low political feasibility.

The Public and Political Acceptability of Road Pricing Schemes

The public acceptability of road pricing schemes is directly related to political feasibility, as demonstrated by the evidence in both successful and failed road pricing schemes, particularly so for well documented failed ones such as the Hong Kong and Edinburgh road pricing plans, where low public support directly caused the plans to be dropped by the local transport authorities (Selmoune et al. 2020). Road pricing measures have less public acceptability compared to soft TDM measures because they are often perceived as coercive measures to reduce car use. Acceptability would be higher if a road pricing plan meets several required conditions, such as good public communications, closer to public expectations, a high level of

perceived effectiveness, and simpler to understand and implement procedures (Dieplinger & Fürst 2014; Fürst & Dieplinger 2014).

The barriers for implementing road pricing are not only about whether the plan is analytically sound, but also whether it is ideologically appealing (Ison 2018). In reviewing both the successful and failed cases, Selmourne et al. (2020) pointed out that the main factors influencing the outcome of the road pricing schemes are equity/fairness, privacy, risk, and difficulty in implementation, as well as administrative issues and installation costs. Hensher and Li (2013) pointed out that the two most important reasons why road pricing referenda failed are uncertainty about the scheme's effectiveness and the lack of information on it. They proposed a two-step approach to overcome these barriers, where good communications are facilitated during both the design and implementation stages, as occurred in Stockholm. Other researchers welcomed the two-step approach in improving the acceptability of road pricing (e.g., Dieplinger & Fürst 2014). Similarly, Duncan and Graham (2013) named adequacy, equity, simplicity and efficiency as key factors for higher acceptability of road pricing.

Equity or fairness has always been a top priority for road pricing acceptability. Some researchers hold that road pricing schemes are more unfair to lower-income households because they have fewer options compared to their higher-income counterparts when it comes to travel choices (e.g., Glaeser et al. 2023). This is why the distribution of costs and benefits from road pricing schemes has always been a key consideration when it comes to surveys and stated preference experiments (e.g., Beck et al. 2011; Hensher et al. 2013; Balbontin et al. 2017). It can be argued that the fundamental principle of road pricing has a level of embedded fairness because transportation resource usage is charged based on consumed units, either in distance or time. Other measures in reducing car use, such as road restrictions, do not have this characteristic because they apply to all people regardless of their needs. As put by Schade and Schlag (2003), the more people perceive that the advantages of a road pricing plan align with their expectations, the more they will be willing to accept it.

Perceived effectiveness in reducing congestion-related costs through easing congestion and increasing speed has been an important determinant for the success of implemented road pricing plans in Singapore, London, Stockholm, and other places. Reviews of the successful road pricing schemes discovered that public acceptability increased after the public noticed the effectiveness of the implemented schemes (e.g., Anas & Lindsey 2011; Gu et al. 2018; Nilsson et al. 2016). For example, using three waves of panel surveys of 4,700+ respondents before and after the Gothenburg pricing scheme, Nilsson et al. (2016) show that the positive changes in acceptance and attitudes among the public towards the scheme was mainly based on underlying value-based motives promoted by effective outcomes and simple to follow administration.

Duncan and Graham (2013) also emphasised the importance of having simple and low-tech ways of implementing distance-based road pricing charges in the US, such as the vehicle miles of travel fees (VMT-F) among the US public. They argued that low-tech and straightforward ways of road pricing implementation, accompanied by a well-developed audit mechanism, would be critical in gaining more support from the US public for road pricing to make it politically acceptable.

Most of the empirical research using stated preference methods to elicit the levels of public preference aims to enhance these above aspects, namely, a clear definition of the distribution of costs and benefits in favour of the public preference, more effective outcomes, and simplicity in the mechanism. Some studies tested innovative ways in packaging and designing the road pricing

schemes in alternative approaches, different to standard distance-based, area-based or time-based charges (Hensher et al. 2013; Hensher & Mulley 2014; Hensher & Ho 2015). Using a structural equation model, Morton et al. (2021) show that public attitudes towards a Low Emission Zone (LEZ) and related charges (i.e., cordon) account for the most considerable weight in acceptability. Public attitudes are shaped by perceptions of the cost, procedural fairness, and efficacy of the scheme.

In summary, past research on acceptability has consistently indicated that equity and fairness, effectiveness in generating expected outcomes, and simplicity in implementation are essential factors in gaining higher public acceptability.

Empirical Context

A survey was undertaken in May 2025 with participants from Australia, Finland, New Zealand, the United States, the United Kingdom, Singapore, and Sweden. This cross-cultural approach aims to identify both universal and region-specific insights into behaviour change. In this paper, we draw on data items related to eight pricing initiatives (Figure 1), and “windows of change” (WoC) influences listed in Table 1, which represent key moments where travel behaviour might be more susceptible to change. We also include the socioeconomic variables in the inquiry.

How has your local travel changed since we came out of COVID-19 restrictions?

Your Views on Travel-Influencing Initiatives

Governments, businesses, and other organisations often propose initiatives to influence how people travel.

Below are a range of such initiatives. Please rate each initiative on a scale from “Big Negative Impact” to “Big Positive Impact”.

These initiatives focus on managing congestion and improving travel times through road pricing strategies.

Road Pricing and Tolling Policies	Big negative	Some negative	No impact	Some positive	Big positive	Not apply
Peak-period road user charge AU\$0.05/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
Peak-period road user charge AU\$0.10/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
Peak-period road user charge AU\$0.15/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
Peak-period road user charge AU\$0.20/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
Congestion-free lanes what you pay AU\$0.05/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
Congestion-free lanes what you pay AU\$0.10/km	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
A supplementary charge of AU\$15 per car in a defined area around the city which is designed to reduce congestion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
A supplementary charge of AU\$10 per car in a defined area around the city which is designed to improve air quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>

Back Next

© 2025 ITLS, The University of Sydney Business School

Figure 1. The series of questions on road pricing initiatives

Table 1. The list of Windows of Change potential influences

Lifestyle and household changes	Transport and Mobility Changes
Moved to a new area	Bought a car (previously did not own one)
Upsized to a larger home	Increased the number of cars in the household
Downsized to a smaller home (apartment/townhouse)	Replaced a petrol/diesel car with an electric (hybrid or fully electric) car
Household size increased (e.g., new family members)	Replaced a petrol/diesel car with a more fuel-efficient petrol/diesel car
Household size decreased (e.g., children moved out)	Replaced a petrol/diesel car with a less fuel-efficient petrol/diesel car
I changed marital status	Reduced car use due to high costs
I started or increased caregiving responsibilities (e.g., caring for children, elderly)	We now have more cars than adults in the household
My health improved	We now have fewer cars than adults in the household
I had health concerns that affected my travel	I no longer own a car
I started walking/exercising more for health reasons	Purchased an e-scooter
My financial situation improved	Purchased an e-bike
My financial situation became tighter, affecting my spending/travel choices	Purchased a regular bicycle
I have adjusted my lifestyle to prioritise saving money	Improved accessibility of public transport in my area
I increased online shopping to reduce personal travel	Improved public transport routes saved me travel time
I have reduced online shopping spending	Public transport is less crowded since COVID-19
I started using click-and-collect more often	Public transport quality has worsened
I now rely more on home delivery	I reduced car use for commuting
I acquired a dog	I started using public transport more for commuting
I no longer have a dog	I reduced overall car use
I retired from the workforce	I increased overall car use
I was temporarily not working	I walk or cycle more
My partner retired	I increased my use of e-bikes or e-scooters
My partner changed jobs	I take children to/from daycare or school on the way to/from work/home
My partner started or re-entered the workforce	I use public transport more because other household members use the car
My partner moved to more flexible working hours	I walk/cycle more because other household members use the car
Work and commuting changes	I use e-bike/e-scooter more because other household members use the car
I was not in the workforce during this period	Environmental and Social considerations
I was looking for a job during this period	I am now more conscious of the environmental impact of my travel choices
I changed jobs but stayed in the same residential area	I am now less concerned about the environmental impact of my travel choices
I changed jobs and moved to a new residential area	Friends influenced my decision making
I moved to flexible working hours and days	Family influenced my decision making
I recently had to work in the main office/work location more at the request of employer	Public campaigns or government policies
My employer introduced free parking	Peer groups and social norms
My employer introduced charging facilities for electric cars	I tend to use car over public transport on wet days
My employer introduced showers for walking/cycling commuters	I tend to use car over active travel on wet days

Lifestyle and household changes	Transport and Mobility Changes
My employer introduced free on-site health & wellness facilities (e.g., gym, yoga)	Due to industrial action, I shifted from public transport to driving
My employer introduced perks for using public transport, carpooling, cycling, or e-scooters (e.g., coffee vouchers, preferential parking)	

Target Audience, Sampling Strategy and Implementation

The survey primarily targeted respondents in Australia, reflecting the local context and transport policies influencing travel behaviour. With a target sample size of 4,000 participants across all countries, it aimed to provide an understanding of local travel patterns and relevant interventions based on their experience during 2023 to now. In addition to 1,000 respondents from Australia, a comparative sample of 1,000 from the USA and 400 each from Finland, New Zealand, the UK, Singapore, and Sweden was obtained to offer a broader perspective, and enable international comparisons. These countries were selected based on their advanced transport systems, progressive policy initiatives, diverse approaches to sustainable mobility, and the ability of respondents to complete the survey in English. By incorporating insights from multiple regions, the survey sought to identify common trends, key differences, and best practices in influencing travel behaviour. This comparative approach supports the assessment of the effectiveness of various interventions and the level of awareness across different urban and policy contexts.

A third-party panel survey provider was engaged to ensure robust data collection, with flexibility in sample sizes to adapt to evolving research needs. The research team continuously monitored data quality throughout the collection period and applied checks at both the pilot and full implementation stages to ensure the validity of survey responses. Accordingly, 526 responses were excluded due to unacceptable data quality. The final sample includes 1,034 respondents from Australia, 1,009 from the USA, 397 from Finland, 423 from New Zealand, 411 from Singapore, 403 from Sweden, and 411 from the UK, a total of 4,088 respondents.

The Generalised Ordered Logit Model

The dependent variable of interest is an ordered response scale as shown in Figure 1. We ignore the ‘not apply’ response, which was selected by a negligible number of respondents. To represent this ordering, we use an order logit (OL) model (see Greene and Hensher, 2010). The basic ordered choice model is based on a latent regression model given as equation (1).

$$Y_i^* = \beta'x_i + \varepsilon_i, \quad \varepsilon_i \sim F(\varepsilon_i | \theta), \quad E(\varepsilon_i) = 0, \quad \text{Var}(\varepsilon_i) = 1 \quad (1)$$

where θ collects the mean and threshold parameters. The observation mechanism results from a complete censoring of the latent dependent variable as follows:

$$\begin{aligned} Y_i &= 0 \text{ if } Y_i^* \leq \mu_0, \\ &= 1 \text{ if } \mu_0 < Y_i^* \leq \mu_1, \\ &= 2 \text{ if } \mu_1 < Y_i^* \leq \mu_2, \\ &\dots \\ &= J \text{ if } Y_i^* > \mu_{J-1}. \end{aligned} \quad (2)$$

The probabilities which enter the log likelihood function are given by equations (3).

$$\text{Prob}[y_i = j | x_i] = \text{Prob}(Y_i^* \text{ is in the } j\text{th range}) = F(\mu_j - \beta'x_i) - F(\mu_{j-1} - \beta'x_i) > 0, j = 0, 1, \dots, J. \quad (3)$$

We depart from the basic model to allow for random thresholds and heterogeneity in the preferences associated with the explanatory variables (Greene and Hensher 2010)³. In order to model heterogeneity in the utility functions across individuals, we construct a hierarchical model in which the parameters vary randomly due to individual-specific unobservables, v_i (equation 4).

$$\beta_i = \beta + \Gamma v_i \quad (4)$$

Γ is a lower triangular matrix and $v_i \sim N[0, I]$. The parameter vector in the utility function, β_i is normally distributed across individuals with conditional mean given as (5).

$$E[\beta_i | x_i] = \beta \quad (5)$$

and conditional variance as (6).

$$\text{Var}[\beta_i | x_i] = \Gamma \Gamma' = \Omega. \quad (6)$$

This is a random parameter formulation that is common with mixed logit models for unordered alternatives. In addition, the thresholds are modelled randomly and nonlinearly as

$$\mu_{ij} = \mu_{i,j-1} + \exp(\alpha_j + \delta' r_i + \sigma_j w_{ij}), w_{ij} \sim N[0, 1] \quad (7)$$

with normalisations and restrictions $\mu_{-1} = -\infty$, $\mu_0 = 0$, $\mu_J = +\infty$. For the remaining thresholds, we have the form in (8).

$$\begin{aligned} \mu_1 &= \exp(\alpha_1 + \delta' r_i + \sigma_1 w_{j1}) \\ &= \exp(\delta' r_i) \exp(\alpha_1 + \sigma_1 w_{j1}) \end{aligned} \quad (8)$$

$$\mu_2 = \exp(\delta' r_i) [\exp(\alpha_1 + \sigma_1 w_{j1}) + \exp(\alpha_2 + \sigma_2 w_{j2})],$$

$$\mu_j = \exp(\delta' r_i) \left(\sum_{m=1}^j \exp(\alpha_m + \sigma_m w_{jm}) \right), j = 1, \dots, J-1$$

$$\mu_J = +\infty.$$

This formulation ensures that all of the thresholds are positive, preserves the ordering of the thresholds and incorporates the necessary normalisations. Most importantly, it also allows observed variables and unobserved heterogeneity to play a role both in the utility function and in the thresholds. The thresholds, like the regression itself, are shifted by both observable (r_i) and unobservable (w_{ij}) heterogeneity. The model is fully consistent in that the probabilities are all positive and sum to one by construction. If $\delta = 0$ and $\sigma_j = 0$, then the original OL model is returned, with $\mu_1 = \exp(\alpha_1)$, $\mu_2 = \mu_1 + \exp(\alpha_2)$ and so on⁴.

³ Start values for the GoL are obtained from a previous OL model. Generally, whenever you fit a random parameter (RP) model a seed should be set. For an OL model, the slopes start at 0. Constant and cut points are also set so that theoretical probabilities match shares of outcomes. The RP start values are fixed results with zeros for variances of RPs.

⁴ Note that if the threshold parameters were specified as linear functions rather than as in (8), then it would not be possible to identify separate parameters in the regression function and in the threshold functions.

We can also allow for individual heterogeneity in the variance of the utility function as well as in the mean. The disturbance variance is allowed to be heteroscedastic, specified randomly as well as deterministically. Thus,

$$\text{Var}[\varepsilon_i | h_i, e_i] = \sigma_i^2 = \exp(\gamma' h_i + \tau e_i)^2 \quad (9)$$

where $e_i \sim N[0,1]$. Let $v_i = (v_{i1}, \dots, v_{ik})'$ and $w_i = (w_{i1}, \dots, w_{i,j-1})'$. Combining all terms, the conditional probability of outcome j is

$$\text{Prob}[y_i = j | x_i, z_i, h_i, r_i, v_i, w_i, e_i] = F \left[\frac{\mu_{ij} - \beta_i' x_i}{\exp(\gamma' h_i + \tau e_i)} \right] - F \left[\frac{\mu_{i,j-1} - \beta_i' x_i}{\exp(\gamma' h_i + \tau e_i)} \right], \quad (10)$$

where it is noted, once again, both μ_{ij} and β_i vary with observed variables and with unobserved random terms. The log likelihood is constructed from the terms in (10). However, the probability in (10) contains the unobserved random terms, v_i , w_i and e_i . The term that enters the log likelihood function for estimation purposes must be unconditioned on the unobservables and integrated out to obtain the unconditional probabilities in (11).

$$\text{Prob}[y_i = j | x_i, z_i, h_i, r_i] = \int_{v_i, w_i, e_i} \left(F \left[\frac{\mu_{ij} - \beta_i' x_i}{\exp(\gamma' h_i + \tau e_i)} \right] - F \left[\frac{\mu_{i,j-1} - \beta_i' x_i}{\exp(\gamma' h_i + \tau e_i)} \right] \right) f(v_i, w_i, e_i) dv_i dw_i de_i. \quad (11)$$

One is typically interested in the estimation of parameters such as β in (11), to learn about the impact of the observed independent variables on the outcome of interest. This generalised ordered choice model contains four points at which changes in observed variables can induce changes in the probabilities of the outcomes, in the thresholds, μ_{ij} , in the marginal utilities, β_i , in the utility function, x_i and in the variance, σ_i^2 .

A Descriptive Profile of the Road Pricing Initiatives

The ordered response scale shown in Figure 1 has been aggregated into three levels – negative impact, no impact and positive impact. This decision was taken to ensure we have enough responses for each level of the generalised ordered logit model. Table 2 assigns an acronym to each pricing initiative, which is used in Table 3 and Figure 2 to profile the incidence of response for each impact level. We can see, for example, that as the peak period distance-based charge (DBC) increases from 5c/km to 20c/km, the positive support declines (i.e., getting too expensive), and the negative impact increases for the same logical reason. We find a high correlation in general between the positive and negative impacts. Figure 3 is an example applicable to all initiatives, such that after estimation of the Generalised Ordered Logit (GoL) model for all three impact levels, we focus on reporting and discussing only the positive impact evidence, through elasticity estimates.

A positive impact for an initiative has to be carefully interpreted. Although the meaning can vary depending on the initiative, for the introduction of a new pricing regime, if an initiative has a positive impact, it can mean that it has some support, which can vary and will be dependent on knowing what variables (including the WoC influences) are influencing the direction of positive support. A negative parameter and associated elasticity, for example, suggest that an increase in the level of a particular statistically significant influence, such as car use, *ceteris paribus*,

supports reduced (positive) support for a specific pricing initiative, increasing as car kilometres increase.

Table 2. The eight pricing initiatives

Road Pricing Schemes	Acronyms
Congestion-free lanes what you pay \$0.05/km	ICFL05
Congestion-free lanes what you pay \$0.10/km	ICFL10
A supplementary charge of \$10 per car in a defined area around the city	CH10CR
A supplementary charge of \$15 per car in a defined area around the city	CH15CR
Peak-period road user charge US\$0.05/km (Distance-Based Charge)	DBC05
Peak-period road user charge US\$0.10/km (Distance-Based Charge)	DBC10
Peak-period road user charge US\$0.15/km (Distance-Based Charge)	DBC15
Peak-period road user charge US\$0.20/km (Distance-Based Charge)	DBC20

Note: The initiatives were expressed in the currency of each of the seven countries, but we list the \$US in the table. Respondents saw the language of a peak period road user charge (RUC) which we refer to also as a distance-based charge (DBC).

Table 3. The distribution of impact for each initiative

	DBC05	DBC10	DBC15	DBC20	ICFL05	ICFL10	CH10CR	CH15CR
Negative Impact	28.2%	30.2%	32.6%	33.5%	28.3%	28.6%	34.0%	35.5%
No Impact	38.0%	37.2%	35.9%	34.9%	37.3%	37.6%	32.8%	32.6%
Positive Impact	33.8%	32.6%	31.5%	31.6%	34.4%	33.8%	33.2%	32.0%
Base	3090	3087	3087	3078	3085	3091	3087	3107

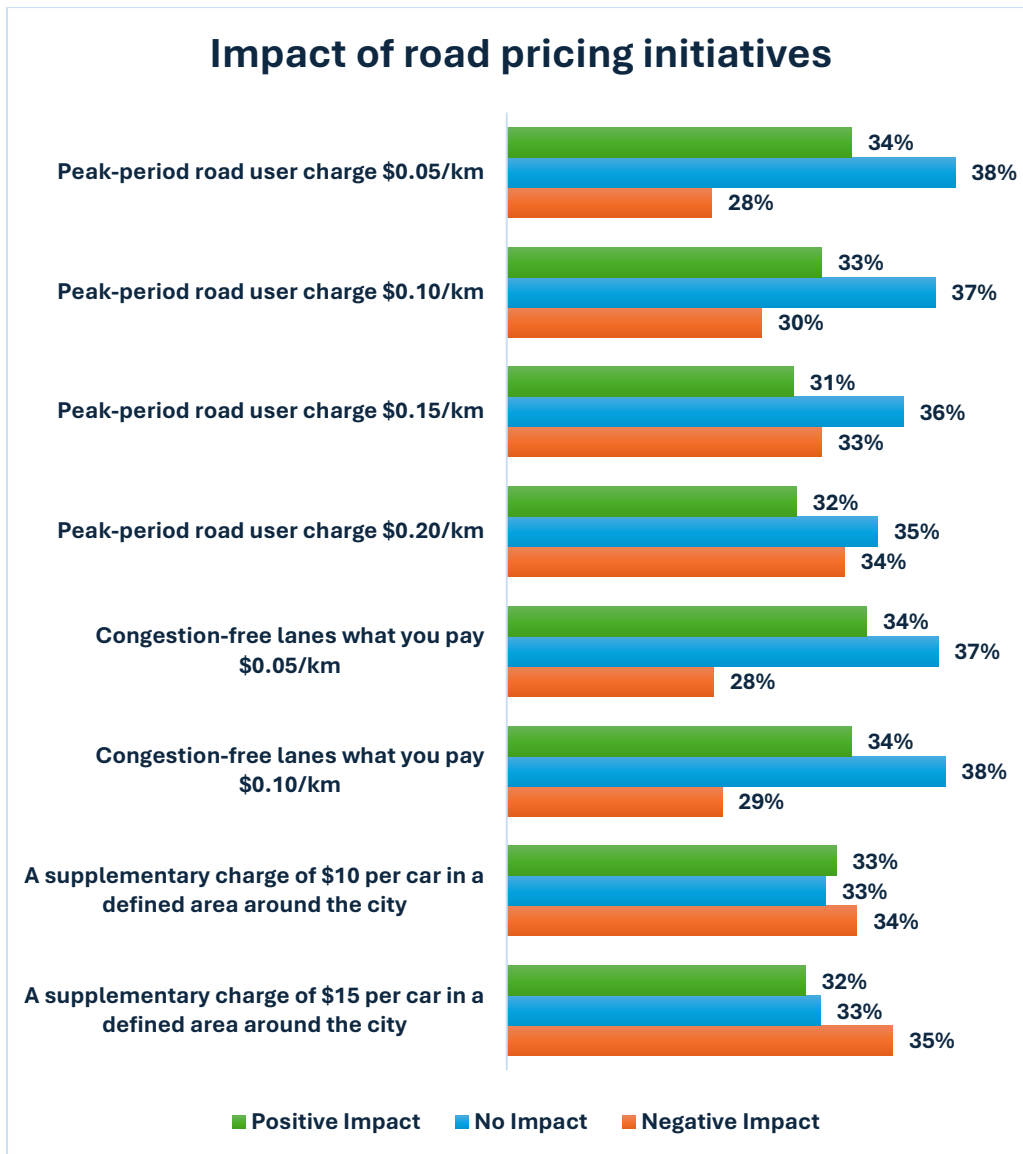


Figure 2. The overall incidence of impact of each pricing initiative

Model Estimation Results

The eight GoL models are summarised in Table 4. While we found statistically significant random parameter effects, there was no evidence of random thresholds or individual heterogeneity in the variance of the utility function as well as in the mean, and heteroscedastic disturbance variance. It is important to recognise that we can have a statistically significant standard deviation parameter but a non-significant mean parameter estimate, suggesting that preference heterogeneity is present, and that a mean estimate alone fails to accommodate this empirical evidence.

The influence of each WoC varies across the eight road pricing regimes, with a significant number not having a statistically significant influence. For example, age is statistically significant in all eight models, whereas personal income is only statistically significant for a \$15 cordon-based charge. The sign has to be interpreted mindful of the three-point scale, and because of the possibility of a change in sign when moving between a positive and negative impact, an elasticity

estimate associated with each level is behaviourally more informative. The negative sign for age in all models, however, suggests that there is an overall net support decrease as age increases. In contrast, the sign of personal income suggests greater support for a cordon-based \$15 charge as income increases (they can afford it and presumably see a benefit through reduced traffic).

The country-specific dummy variables are very informative, with evidence that residents of Finland (where congestion charges have never been introduced), and the UK have a significant negative parameter for all eight pricing regimes, but for Australia and New Zealand the statistically significant negative impact is found only for the \$15 cordon-based charge. Swedish residents, however, show a positive significant effect for a \$10 cordon-based charge, presumably because of experience with the schemes in Stockholm and Gothenburg, and a negative sign for a 5c/km congestion-free lane⁵. After controlling for WoCs and a few socioeconomic effects, we can see that the influence of each pricing regime varies across countries, as expected.

There are five WoC influences that have a statistically significant influence on all eight pricing regimes, namely 'My financial situation became tighter' (negative parameter), 'I have adjusted my lifestyle to prioritise saving money' (negative parameter), 'My employer introduced charging facilities for electric cars' (positive parameter), 'Public transport quality has worsened' (negative parameter), and 'I am now more conscious of the environmental impact of my travel choices' (positive parameter). The signs all make good sense, suggesting that financial constraints (exacerbated by the current cost-of-living crisis being experienced in many countries) make the pricing reforms less desirable, as does the worsening quality of public transport, which makes any switch from car less desirable. Then we see that the employer introducing charging facilities for electric cars at the workplace is sufficiently attractive to support road pricing reforms, which might appear to be an attractive way of improving travel times to work, and in many countries, electric car owners generally have higher personal incomes and a tendency to drive more once they have switched to an EV. Recent evidence from Norway which has taken up electric cars more than any other country shows a 10-20% increase in car use and a sizeable shift away from public transport use, cycling and walking (Green and Østli 2-25). Finally, we see positive support from individuals who are now more environmentally conscious. The behavioural richness of the evidence is greater when we present the elasticity estimates which we have summarised in the next section.

⁵ Note that we had a fairly even split of metro (212) v regional (177) respondents in Sweden suggesting that regional residents are also responding positively

Table 4. Generalised ordered logit model estimation results

	DBC \$0.05/km	DBC \$0.10/km	DBC \$0.15/km	DBC \$0.20/km	Congestion free lanes \$0.05/km	Congestion free lanes \$0.10/km	Cordon- based \$10	Cordon- based \$15
Variables	Latent Regression Equation Parameters							
Constant	1.9558 (10.67)	2.1763 (11.88)	1.8845 (10.23)	2.1265 (10.01)	1.8328 (9.47)	1.8007 (8.96)	2.1382 (10.93)	2.1932 (11.76)
Number of ICE cars	- 0.2427 (5.63)	- 0.3597 (- 7.79)	- 0.2289 (- 5.07)	- 0.3368 (- 6.76)	-0.1975 (- 4.74)	- 0.2224 (- 4.85)	- 0.2578 (- 5.83)	- 0.2510 (- 5.87)
Total public transport trips	0.0225 (2.65)		0.0187 (2.21)	0.0170 (1.86)	0.0223 (2.52)	0.0210 (2.27)	0.0118 (1.32)	
Total E-bike trips		0.0453 (2.35)		0.0419 (1.56)	0.0522 (2.46)	0.0335 (1.50)	0.0386 (1.67)	0.0486 (2.52)
Age	- 0.0161 (- 5.91)	- 0.0183 (- 6.55)	- 0.0158 (- 5.62)	- 0.0173 (- 5.61)	-0.0123 (- 4.30)	- 0.0130 (- 4.35)	- 0.0242 (- 8.31)	- 0.0207 (- 7.46)
Personal income								0.0033 (2.27)
Australia								- 0.4916 (- 3.02)
Finland	- 0.4425 (- 3.15)	- 0.5461 (- 3.87)	- 0.3952 (- 2.75)	- 0.4603 (- 2.92)	-0.6338 (- 4.18)	- 0.5430 (- 3.38)	- 0.2589 (- 1.80)	- 0.5038 (- 3.43)
New Zealand								- 0.4311 (- 3.19)
Sweden					-0.2696 (- 1.78)		0.4039 (2.65)	
UK	- 0.4041 (- 3.02)	- 0.5233 (- 3.74)	- 0.5101 (- 3.65)	- 0.5932 (- 4.02)	-0.4059 (- 2.96)	- 0.3826 (- 2.60)	- 0.5652 (- 4.00)	- 0.7470 (- 5.02)
Upsized to a larger home	0.2534 (1.50)		0.3645 (1.93)	0.5293 (2.45)		- 8.0131 (- 3.66)		
Household size decreased		0.2657 (1.82)	0.2435 (1.66)			0.5664 (3.53)		
My financial situation improved						0.2449 (1.81)		
My health improved					0.2945 (2.29)		0.2214 (1.87)	
I started walking/exercising more for health reasons			- 0.2584 (- 2.55)	- 0.3021 (- 2.72)	-0.2099 (- 2.05)			- 0.1712 (- 1.65)
My financial situation became tighter	- 0.5498 (- 5.24)	- 0.5842 (- 5.22)	- 0.6122 (- 5.37)	- 0.6309 (- 5.02)	-0.5371 (- 4.96)	-0.5321 (3.78)	- 0.6380 (- 5.81)	- 0.6661 (- 6.22)

I have adjusted my lifestyle to prioritise saving money	- 0.3432 (- 2.76)	- 0.4972 (- 3.27)	- 0.3491 (- 2.43)	- 0.5039 (- 3.40)	-0.2850 (- 2.17)	-0.3872 (3.97)	- 0.6899 (- 4.36)	- 0.5662 (- 4.35)
I started using click-and-collect more often	- 0.3951 (- 1.98)	- 0.3037 (- 1.81)	- 0.4966 (- 2.87)	- 0.5112 (- 2.47)				- 0.3130 (- 1.81)
I acquired a dog		- 0.2644 (- 1.65)	- 0.3241 (- 1.87)	- 0.3066 (- 1.73)	-0.4014 (- 2.43)	- 0.5279 (- 2.66)	- 0.5070 (- 2.38)	- 0.6947 (- 3.80)
I no longer have a dog					-0.3305 (- 1.60)			
I started or increased caregiving responsibilities							- 0.3968 (- 2.15)	- 0.3741 (- 2.08)
My partner retired					-0.6760 (- 2.00)			
I now rely more on home delivery	0.2795 (1.48)	- 0.4806 (- 1.53)	- 0.2970 (- 0.73)					
My partner changed jobs	- 0.6038 (-1.85)							
My partner started or re-entered the workforce	1.3473 (1.42)		0.7939 (1.64)					
I changed jobs but stayed in the same residential area				- 0.3596 (- 2.41)	-0.2890 (- 2.00)			
I changed jobs and moved to a new residential area	- 0.6460 (- 2.89)	- 0.3003 (- 1.50)	- 0.5242 (- 2.41)	- 0.4998 (- 2.55)	-0.4492 (- 2.22)		- 0.5262 (- 2.08)	- 0.4501 (- 1.97)
I moved to flexible working hours and days	0.2218 (1.95)	0.2312 (2.26)		0.3039 (2.47)	0.2920 (2.56)	0.4755 (4.88)		
I recently had to work in the main office/work location more	0.2584 (2.02)				0.3477 (2.55)			
My employer introduced charging facilities for electric cars	1.0250 (3.81)	0.8134 (3.47)	0.9418 (4.63)	1.3446 (4.33)	0.9046 (3.15)	0.5890 (2.73)	0.6169 (2.82)	0.9887 (3.78)
My employer introduced showers for walking/cycling commuters			0.5223 (2.85)	0.3705 (1.64)	0.4152 (1.90)	0.5561 (2.71)		0.4290 (2.33)
My employer introduced free on-site health & wellness facilities	0.3562 (1.83)	0.4123 (2.14)	0.4271 (2.15)	0.4142 (1.91)	0.3823 (1.92)	0.4548 (2.10)		
My employer introduced free parking at work	0.4423 (3.28)	0.3909 (2.79)	0.3124 (2.30)	0.4029 (2.59)		0.3462 (2.24)		0.2237 (1.60)
My employer introduced perks for using public transport, carpooling, cycling, or e-scooters		- 0.3283 (- 1.49)						
Bought a car (previously did not own one)					0.3139 (1.92)	0.3043 (1.76)	0.2818 (1.74)	
Increased the number of cars in the household	0.3250 (1.87)	0.5421 (3.07)	0.6028 (3.02)	0.4136 (2.15)	0.4419 (2.05)		0.3437 (1.85)	0.4346 (2.43)

Replaced a petrol/diesel car with a more fuel-efficient petrol/diesel car					-0.3848 (- 2.28)	- 0.3586 (- 1.89)		
Replaced a petrol/diesel car with a less fuel-efficient petrol/diesel car		0.3917 (1.90)	0.8040 (2.51)	0.9091 (2.96)	0.4848 (1.84)		0.7117 (3.20)	0.8149 (3.85)
I no longer own a car			0.3233 (1.73)		0.3678 (1.89)	0.4262 (2.11)		0.3717 (1.95)
Public transport quality has worsened	- 0.4280 (- 2.31)	- 0.3953 (- 2.03)	- 0.6038 (- 3.63)	- 0.6094 (- 3.39)	-0.5629 (- 3.02)	- 0.6649 (- 2.29)	- 0.7906 (- 3.89)	- 0.4498 (- 2.59)
Reduced car use due to high costs							0.2770 (1.85)	0.2258 (1.58)
I use public transport more because other household members use the car							0.9609 (3.20)	0.8224 (2.91)
Replaced a petrol/diesel car with an electric (hybrid or fully electric) car							0.4100 (2.39)	
Purchased an e-scooter							0.6193 (2.15)	
Purchased an e-bike							0.3688 (1.95)	
We now have more cars than adults in the household		0.4723 (1.62)						
I reduced overall car use			- 0.2362 (- 1.81)	- 0.3565 (- 2.16)				
I increased overall car use		- 0.4723 (- 2.29)	- 0.3162 (- 1.65)	- 0.5255 (- 2.16)				
I increased my use of e-bikes or e-scooters				- 1.0096 (- 1.74)				
I am now more conscious of the environmental impact of my travel choices	0.5188 (5.99)	0.5538 (6.09)	0.5475 (6.30)	0.5483 (5.40)	0.5219 (5.75)	0.5128 (5.92)	0.7163 (7.33)	0.6818 (7.07)
Friends for decision making					0.3022 (2.34)			
Peer groups and social norms for decision making				0.7489 (2.50)	0.6030 (1.95)	0.7439 (2.56)		
Family for decision making	0.3714 (3.51)	0.3130 (3.06)	0.1958 (1.98)	0.2072 (1.95)		- 0.4256 (- 4.73)	0.2675 (2.57)	0.1935 (1.91)
Public campaigns or government policies						- 0.5022 (- 2.04)		
I tend to use car over public transport on wet days						- 0.1088 (- 0.83)	- 0.2768 (- 2.33)	- 0.2922 (- 2.63)
I tend to use car over active travel on wet days			- 0.2505 (- 1.95)				- 0.3228 (- 2.23)	

Due to industrial action, I shifted from public transport to driving	- 0.5989 (- 2.35)			- 0.9350 (- 2.98)	-0.7668 (- 2.75)			- 0.4208 (- 1.54)
Intercept Terms in Random Thresholds								
Alpha-01	0.7405 (19.74)	0.7310 (17.59)	0.7033 (18.35)	0.7622 (17.55)	0.7494 (18.59)	0.8376 (20.08)	0.6615 (15.62)	0.6175 (14.42)
Standard Deviations of Random Regression Parameters								
Upsized to a larger home	1.3973 (3.95)		2.1124 (5.43)	2.1070 (4.73)		1.0340 (3.77)		
Household size decreased						3.4741 (3.32)		
My health improved					0.8067 (2.78)			
I started walking/exercising more for health reasons								0.5751 (1.77)
My financial situation became tighter	0.8684 (3.27)	0.9610 (3.17)	1.0624 (4.17)	1.0852 (3.78)	0.8353 (3.33)	0.7304 (4.17)		
I have adjusted my lifestyle to prioritise saving money	0.9424 (3.18)	1.4694 (5.16)	1.3631 (4.68)	1.0203 (3.52)	1.0456 (3.63)	1.4153 (4.40)	1.7006 (4.89)	1.1379 (3.51)
I started using click-and-collect more often	1.1471 (2.83)			0.9959 (2.26)				
I acquired a dog			0.7440 (1.60)			0.9696 (2.34)	1.2063 (2.52)	0.6319 (1.70)
My partner changed jobs			1.4755 (1.95)					
My partner started or re-entered the workforce	2.4074 (1.66)							
I changed jobs but stayed in the same residential area				1.0038 (2.59)	0.9904 (3.16)			
I changed jobs and moved to a new residential area	1.7123 (3.67)	0.8244 (1.99)	1.2870 (3.16)		1.3917 (2.91)		2.1320 (3.78)	1.9078 (3.38)
I moved to flexible working hours and days	0.9202 (3.36)			0.8275 (3.09)	0.6636 (2.34)	1.2.420 (4.86)		
Charging facilities for electric cars	1.0544 (1.63)	0.9686 (2.01)		1.9380 (3.80)	1.5661 (2.63)	3.0623 (2.31)		1.3060 (2.94)
Showers for walking/cycling commuters				0.7954 (1.53)	0.9885 (2.29)	0.3225 (2.46)		
Increased the number of cars in the household			1.0952 (2.41)		1.3304 (2.78)			
Replaced a petrol/diesel car with a more fuel-efficient petrol/diesel car						0.8914 (1.70)		

Replaced a petrol/diesel car with a less fuel-efficient petrol/diesel car			2.1432 (3.51)	1.7647 (2.75)	1.0320 (1.67)			
Public transport quality has worsened	1.0221 (2.43)	1.0945 (2.86)			1.0130 (2.35)	0.7249 (2.02)	0.9942 (1.96)	
Purchased an e-scooter							1.0908 (2.09)	
I reduced overall car use				1.1121 (2.92)				
I increased overall car use		0.9767 (2.09)	0.8312 (1.69)	1.4720 (3.01)				
I am now more conscious of the environmental impact of my travel choices		0.7570 (3.36)		1.0579 (4.88)	0.5346 (2.19)	2.8897 (5.37)	1.2057 (5.52)	1.1309 (5.78)
Friends for decision making					0.6526 (2.09)			
Peer groups and social norms for decision making						0.2708 (2.11)		
Family for decision making	0.8691 (3.28)	0.9563 (3.76)	1.0303 (4.41)	0.5422 (1.65)		0.2931 (4.84)	0.9485 (3.94)	0.9950 (3.78)
Public campaigns or government policies						0.6809 (2.12)		
I tend to use car over public transport on wet days						0.6414 (2.58)	0.7792 (2.24)	
I tend to use car over active travel on wet days							0.9734 (2.62)	
Model Fit Statistics								
Log Likelihood	-3157.06	-3144.61	-3150.28	-3105.8	-3153.51	-3145.66	-3128.87	-3146.29
AIC	6384.1	6357.20	6380.60	6299.60	6399.00	6375.30	6333.70	6366.60
AIC/N	2.066	2.059	2.067	2.047	2.074	2.063	2.036	2.049
Base	3090	3087	3087	3078	3085	3091	3112	3107

Elasticity Evidence

The mean direct elasticities associated with a negative and a positive impact are summarised in Table 5 and for positive impacts only in Figures 3 and 4. The interpretation of a negative and a positive impact needs to be explained, and the direction of change will depend on the sign of the elasticity estimate. Taking the positive impact first (P column), an elasticity with a positive parameter estimate suggests, *ceteris paribus*, that a participant who experienced that WoC relative to one that did not, or those who have a higher value in the level of a continuous variable (e.g., are older) are more likely to perceive a positive impact, which can be interpreted as greater support for that particular pricing reform. On the contrary, a negative elasticity associated with a positive impact (P column) response suggests, *ceteris paribus*, that these participants are less likely to perceive a positive impact. That is, people could still support the reform, but not as strongly as those in the first category (who have experienced that WoC or are older in the example above).

In contrast, if there is a positive elasticity estimate in the negative impact (N column), this means participants who have experienced that WoC or have a higher value in the continuous variable (i.e., older), are, *ceteris paribus*, more likely to perceive this reform as having a negative impact. We can interpret this as a much greater negative support for that particular road pricing reform. Whereas a negative elasticity in the negative impact column (N column), suggests a reduced but still negative support for the reform. We focus on discussing the positive impacts, noting that there appears to be strong symmetry between the negative and positive impacts, albeit a negative correlation.

To take an example, for the 'total number of public transport trips' explanatory variable, we have a small positive elasticity for all levels of the peak-period road user charges (DBC) (0.050, 0.039, 0.037), which suggests, *ceteris paribus*, that as the number of public transport trips increases by 10%, the probability of supporting a DBC at any level increases by 0.37% to 0.5%. The elasticities associated with congestion-free lanes are 0.048 and 0.036 respectively for AUD 5c/km and AUD 10 c/km, with 0.023 for a cordon-based charge of \$10 per day (not being significant for \$15 per day). The smaller relative elasticity for a cordon-based charge is expected since it is limited to a smaller geographical setting than the DBC and hence it impacts far fewer residents, but interestingly, the congestion-free lane charge has a similar estimate to a DBC, partly linked to the typical length beyond the city centre. For all road pricing reforms (RPR) in Table 5, we have a small percentage impact of the number of public transport trips, varying from 0.23% to 0.5% for a 10% increase in the number of PT trips. Clearly PT users are 'happy' for car users to be charged, possibly benefitting bus where it shares the road with cars or some view that car users do not pay for the congestion they cause.

By contrast, as the number of ICE cars (i.e., petrol/diesel cars) in a household increase, the probability of a positive impact of a DBC decreases and much more than the PT increase (-0.167 to -0.228), which means that a household with 1 ICE car relative to 0 would be between 16.7% to 22.8% more likely to support the DBC. A negative elasticity always suggests a less desirable outcome (i.e., suggesting less support for the schemes) when a variable is relevant in the case of WoCs. For example, where a worker has been offered free parking at the office, the introduction of a DBC has a positive elasticity (0.022 to 0.033) suggesting that there is greater positive impact of the DBC. This suggests that for commuters who drive to work and benefit from the free parking at work, believe DBC is likely to make a positive impact to their routine commuting possibly because it may ease traffic and congestion. This is an interesting result, indicating that

individuals as commuters are positive in supporting road pricing reform but tempered, in this case, by end of trip facilities which can be influenced by an employer. In contrast, where an individual increased their car use, they have a negative elasticity response (-0.011 to -0.019) for only the DBC reforms of \$0.15/km and \$0.20/km. This suggests that those who have increased their car use are between 1.1% to 1.9%, *ceteris paribus*, less likely to perceive a positive impact of the \$0.15-0.20/km DBC reforms, and do not have a statistically significant different perception when it comes to the \$0.05-0.10/km DBC reforms.

The largest behavioural elasticity response associated with the WoCs is for a greater consciousness of the environmental impact of an individual's travel choices (who are between 11.7% to 16.1% more likely to perceive a positive impact), followed by a person's financial situation becoming tighter (who are between 5.1% to 8.0% less likely to perceive a positive impact), and in both influences, it applies across all eight road pricing reforms. Again, it should be remembered that this relates to experiences within the last 3 years when a certain amount of lifestyle reprioritisation may have taken place following the impact of COVID-19. The majority of the other mean direct elasticities are typically at the 1% to 3% level, and as dummy variables, this is interpreted for a situation where an influence moves from being influential (1) or not (0).

The country-specific elasticities are interesting, with the statistical significance of the parameters associated with each explanatory variable varying across the eight pricing regimes. Finland is the only country where we have a significant negative relative elasticity response for positive impact across all eight pricing regimes, varying from 1.34% for a cordon-based charge of \$10 to 3.65% for congestion-free lanes priced at 5 c/km. Where there is a country-specific negative effect on a positive impact, the levels vary from a high of -7.4% for Australia (cordon-based charge of \$15) to a low of -1.6% in Sweden (for congestion-free lanes priced at 5 c/km).

A comparison across all pricing regimes where we calculate the ratio of the DBC over each of the other two pricing regimes (Figure 5) can provide a useful way of understanding the different behavioural responses to the pricing regimes. The evidence suggests a much higher elasticity response for a DBC, with a few exceptions, and this is expected given that a DBC is areawide, and therefore more visible, in contrast to the narrower geographical context of the other two pricing regimes. The ratio varies from a high of 6.92 for 'free parking at work' for the ratio of a DBC to cordon-based charging and 5.56 relative to a congested free pricing lane, to a low of -0.63 for "my financial situation became tighter" for the ratio of a DBC to congested free priced lanes. This negative ratio reinforces the greater lack of support for a DBC.

Table 5. The mean estimates of direct elasticities associated with the eight road pricing reform initiatives

Variables	DBC \$0.05/km		DBC \$0.10/km		DBC \$0.15/km		DBC 0.20/km		Congestion free lanes \$0.05/km		Congestion free lanes \$0.10/km		Cordon-based \$10		Cordon-based \$15		
	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	
Number of ICE cars	0.142	-0.167	0.245	-0.212	0.135	-0.147	0.156	-0.228	0.111	-0.133	0.137	-0.118	0.142	-0.155	0.133	0.167	-
Total public transport trips	-0.043	0.050			-0.035	0.039	-0.025	0.037	-0.040	0.048	-0.041	0.036	-0.021	0.023			-
Total E-bike trips			-0.036	0.031			-0.022	0.033	-0.034	0.040	-0.024	0.020	-0.024	0.027	0.030	0.037	-
Age	0.389	-0.458	0.513	-0.445	0.384	-0.419	0.330	-0.483	0.286	-0.342	0.331	-0.284	0.550	-0.601	0.457	0.571	-
Personal income															0.033	0.041	-
Australia															0.060	0.074	-
Finland	0.022	-0.026	0.032	-0.028	0.020	-0.022	0.018	-0.027	0.031	-0.036	0.029	-0.025	0.012	-0.013	0.023	0.029	-
New Zealand	0.019	-0.023	0.029	-0.025	0.025	-0.027	0.023	-0.033							0.022	0.028	-
Sweden									0.014	-0.016			-0.020	0.022			-
UK									0.019	-0.022	0.019	-0.017	0.026	-0.028	0.033	0.041	-
Upsized to a larger home	-0.014	0.016			-0.020	0.022	-0.023	0.033			0.449	-0.386					-
Household size decreased			-0.014	0.012	-0.011	0.012					-0.272	0.234					-
My financial situation improved											-0.018	0.015					-
My health improved									-0.027	0.032			-0.020	0.022			-
I started walking/exercising more for health reasons					0.030	-0.033	0.028	-0.041	0.024	-0.028					0.018	0.023	-
My financial situation became tighter	0.058	-0.068	0.072	-0.063	0.065	-0.071	0.053	-0.077	0.055	-0.065	-0.594	0.511	0.063	-0.069	0.064	0.080	-
I have adjusted my lifestyle to prioritise saving money	0.025	-0.029	0.041	-0.036	0.025	-0.028	0.029	-0.042	0.020	-0.023	-0.292	0.251	0.047	-0.051	0.037	0.046	-
I started using click-and-collect more often	0.012	-0.014	0.011	-0.009	0.015	-0.016	0.012	-0.018							0.008	0.010	-
I acquired a dog			0.010	-0.009	0.010	-0.011	0.008	-0.011	0.012	-0.015	0.018	-0.015	0.015	-0.017	0.020	0.025	-

I now rely more on home delivery	-0.007	0.008														
My partner changed jobs	0.005	-0.006	0.005	-0.004	0.002	-0.003										
My partner started or re-entered the workforce	-0.005	0.006				-0.003	0.003									
I no longer have a dog									0.006	-0.007						
I started or increased caregiving responsibilities													0.011	-0.012	0.010	0.013
My partner retired									0.004	-0.005						
I changed jobs but stayed in the same residential area								0.020	-0.018	0.019	-0.023					
I changed jobs and moved to a new residential area	0.020	-0.024	0.011	-0.009	0.016	-0.018	0.012	-0.029	0.013	-0.016			0.015	-0.017	0.013	0.016
I moved to flexible working hours and days	-0.027	0.031	-0.032	0.028				-0.029	0.042	-0.034	0.040	-0.059	0.051			
I recently had to work in the main office/work location more	-0.017	0.020								-0.021	0.025					
My employer introduced charging facilities for electric cars	-0.029	0.034	-0.026	0.023	-0.026	0.029	-0.029	0.043	-0.024	0.029	-0.172	0.148	-0.016	0.018	0.025	0.032
My employer introduced showers for walking/cycling commuters					-0.016	0.018	-0.009	0.013	-0.012	0.015	-0.181	0.155			0.012	0.015
My employer introduced free on-site health & wellness facilities	-0.010	0.012	-0.014	0.012	-0.012	0.013	-0.009	0.014	-0.011	0.013	-0.014	0.012				
My employer introduced free parking at work	-0.028	0.033	-0.028	0.025	-0.020	0.022	-0.020	0.029				-0.023	0.019		0.012	0.016
My employer introduced perks for using public transport, carpooling, cycling, or e-scooters			0.008	-0.007												
Bought a car (previously did not own one)									-0.013	0.016	-0.014	0.012	-0.012	0.013		
Increased the number of cars in the household	-0.011	0.013	-0.021	0.018	-0.021	0.023	-0.011	0.016	-0.014	0.017			-0.011	0.012	0.013	0.016
Replaced a petrol/diesel car with a more fuel-efficient petrol/diesel car										0.013	-0.016	0.014	-0.012			
Replaced a petrol/diesel car with a less fuel-efficient petrol/diesel car			-0.010	0.009	-0.018	0.020	-0.017	0.024	-0.010	0.012			-0.015	0.016	0.017	0.021
I no longer own a car					-0.009	0.010			-0.010	0.012	-0.013	0.011			0.009	0.012
Public transport quality has worsened	0.014	-0.016	0.015	-0.013	0.020	-0.022	0.016	-0.024	0.018	-0.021	0.229	-0.019	0.024	-0.026	0.013	0.016
Reduced car use due to high costs													-0.014	0.015	0.011	0.014
I use public transport more because other household members use the car													-0.012	0.013	0.010	0.012
Replaced a petrol/diesel car with an electric (hybrid or fully electric) car													-0.015	0.016		
Purchased an e-scooter													-0.013	0.014		

Purchased an e-bike														-0.013	0.014		
We now have more cars than adults in the household			-0.006	0.006													
I reduced overall car use					0.015	-0.016	0.018	-0.026									
I increased overall car use			0.018	-0.015	0.010	-0.011	0.013	-0.019									
I increased my use of e-bikes or e-scooters							0.003	-0.005									
I am now more conscious of the environmental impact of my travel choices	-0.108	0.127	-0.135	0.117	-0.115	0.126	-0.091	0.132	-0.104	0.124	-0.112	0.0967	-0.140	0.153	0.129	-	0.161
Friends for decision making									-0.023	0.028							
Peer groups and social norms for decision making							-0.009	0.013	-0.008	0.010	-0.012	0.010					
Family for decision making	-0.057	0.067	-0.056	0.048	-0.030	0.033	-0.025	0.037			0.068	-0.059	-0.038	0.042	0.027	-	0.034
Public campaigns or government policies											0.203	-0.174					
I tend to use car over public transport on wet days											0.011	-0.009	0.025	-0.028	0.026	-	0.032
I tend to use car over active travel on wet days					0.017	-0.018							0.020	-0.022			
Due to industrial action, I shifted from public transport to driving	0.009	-0.010					0.010	-0.015	0.011	-0.013					0.006	-	0.007

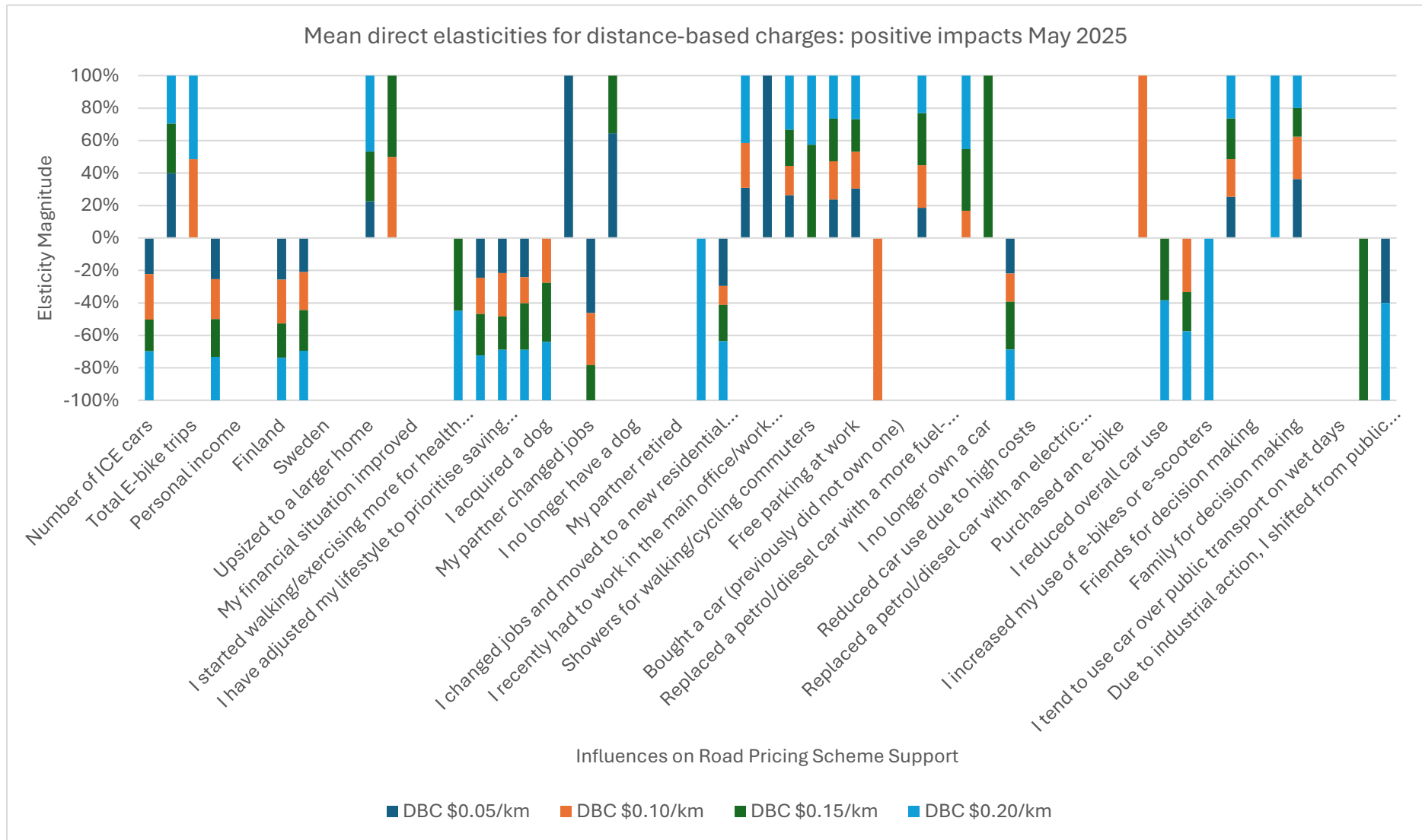


Figure 3. Graphical representation of the mean direct elasticities for the positive impact for the four distance-based charging scenarios

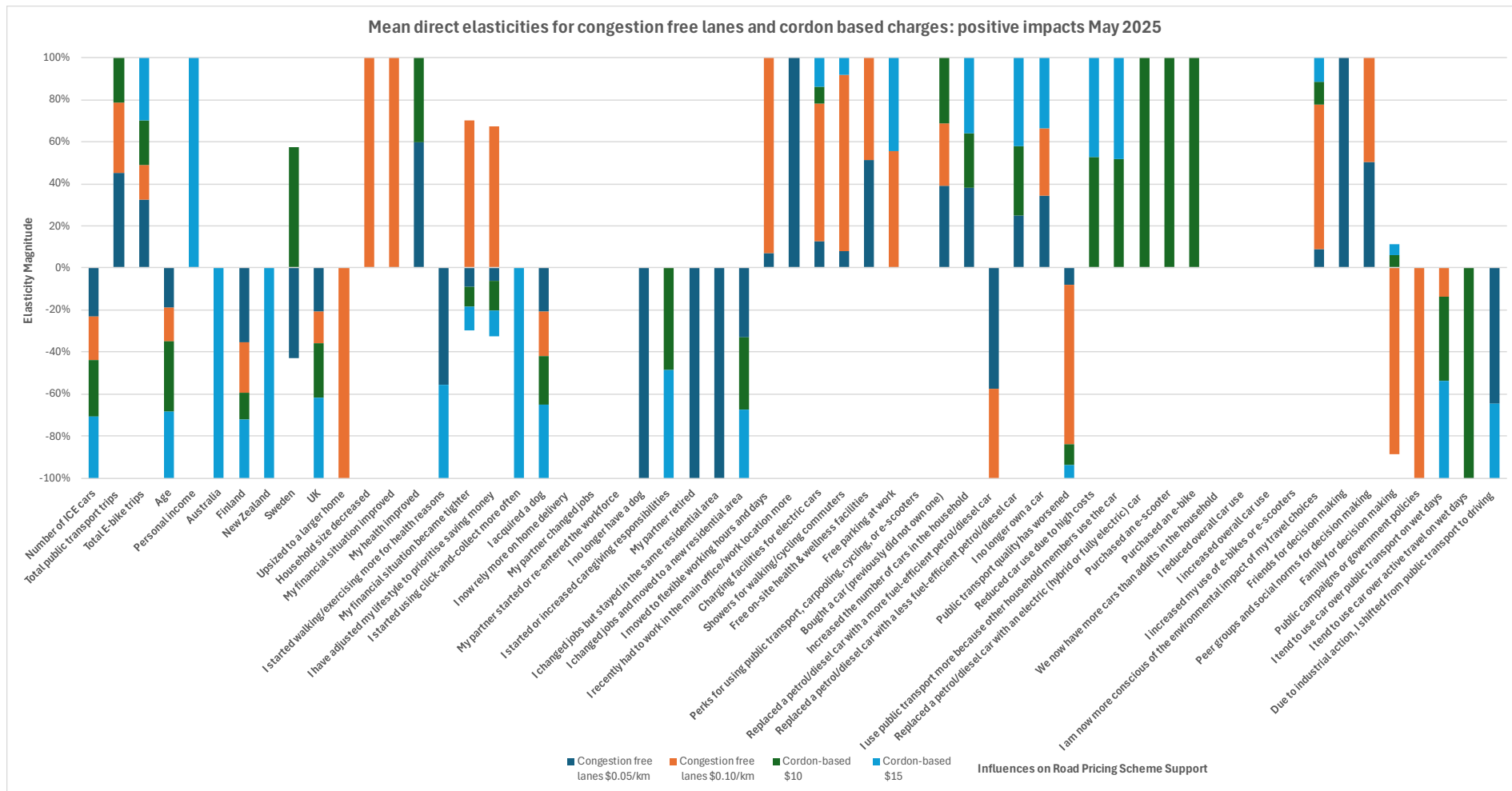


Figure 4. Graphical representation of the mean direct elasticities for the positive impact for the four congestion-free lanes and cordon-based charging scenarios

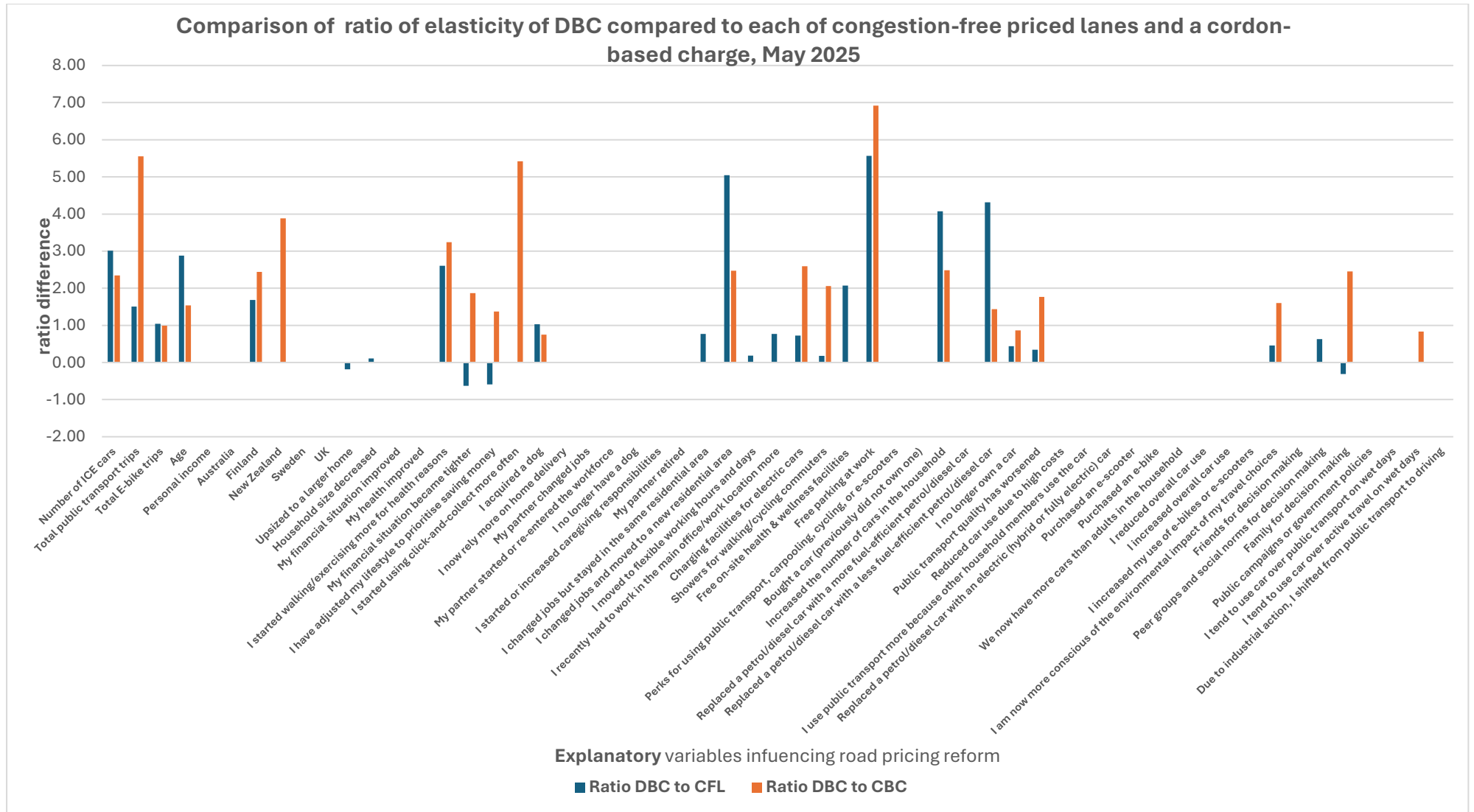


Figure 5. Comparisons of the ratio of a DBC and each of congested free priced lanes and cordon-based charging

Contrasts between the eight initiatives: what are the policy suggestions to carry forward and change action initiatives?

The main focus of this paper is on establishing the extent to which any particular road pricing reform might garner greater support than another pricing regime, as informed by statistically significant drivers that we have identified, be they windows of change (WoC) or other contextual influences. The evidence suggests a number of key drivers that work to provide greater support for specific pricing reforms, and which may be used in a policy setting to promote buy-in for road pricing reforms or which are barriers to achieving a likely future buy-in agenda.

The dominating influences are many, but free parking provided by an employer has an interesting strong positive support. We find that individuals with such free parking tend to be associated with a higher probability of supporting a road user charging regime by kilometre (i.e., distance-based charge, DBC) with a higher probability as the cost per kilometre increases. What this suggests is that since such individuals have free parking, *ceteris paribus*, they are far less sensitive to the DBC, and we conjecture this is because they see improved travel times for them, given that they are committed to car use. This presents an interesting policy dilemma since free parking at work is a strong inducement to travel by car and a disincentive to switch to more environmentally friendly modes. Households that have more cars have negative elasticities which suggests, *ceteris paribus*, that they have a higher probability of not supporting a DBC. Individuals with more consciousness now of the environmental impact of their travel choices tend to support a DBC with a slightly greater support probability as the charge increases per kilometre.

It is important to recognise that a DBC charge applies in peak periods throughout a geographical jurisdiction, whereas a cordon-based charge focuses on a smaller area and applies throughout the day, and a congestion-free lane charge is limited to a specific road or corridor. Overall, we see a greater elasticity response (i.e., sensitivity) to a DBC charge compared to the other pricing regimes (Figure 5) when specific windows of change influences come into play.

The most important actionable change initiatives that can garner positive support for one or more of the eight re-pricing regimes is one that involves promoting environmental consciousness through the many media and other channels available and given the evidence of elasticities influences as an individual ages, the need to especially focus on the younger generation comes through very clearly. We can see that most WoC influences result in a 1%-3% change in the probability of positive support for a road pricing regime, and while this is statistically significant, the impact on overall traveller behaviour is negligible. What we can observe, however, is that for the presence of ICE (i.e., petrol/diesel) cars in a household, for each one-car increase, we see a 11.77% to 22.8% reduction in the positive probability of support for the re-pricing regime proposals. In contrast, as public transport trips increase by 10%, the opposite occurs with a smaller but significant increase in the probability of positive support of 0.26% to 0.51%. Clearly, owning cars will always garner much lower support, and the challenge remains to establish if we have enough evidence to suggest that a majority of car owners do have some positive support for road pricing reform.

Finally, we see that a move to flexible working hours and days which is a strong feature of the last three years, results in a 2.8% to 5.13% increase in the probability of positive support for the road

pricing regimes, which aligns well with the evidence from other studies (see Hensher et al. 2026 for a summary) that working from home (WFH) reduces the sensitivity to cost and time in using the car for travel, especially commuting. Hence, we can expect that we get some significant change in support for road pricing reform given the implied assumption that it benefits existing car users through improved travel times and with increased WFH, one is outlaying less money on car trips even under a proposed re-pricing model.

Overall, the evidence suggests that we have some *actionable change initiatives* that can potentially be effective in securing effective buy-in from the public, but they are few in number. Hensher et al. (2025) identified a number of WoC influences that have resulted in a statistically significant change in the number of trips by car, public transport and active modes, but very few of these WoC influences align with positive support for re-pricing of car use. Where they do align, they tend to go against the objective of encouraging a switch to more sustainable transport modes, namely free parking at work ('the gorilla in the room'), replacing an ICE car with an electric car, and charging facilities at the office for electric cars.

Conclusions

This paper has investigated the role that various past windows of change and current context variables play in determining degrees of support for eight road pricing reforms. While the real test of the impact of such reforms on traffic in the network can only truly be known through an implementation plan, we can, nevertheless, seek out some of the key drivers that support buy-in or are barriers to buy-in. The set of generalised ordered logit models has revealed candidate influences on the probability of supporting to varying degrees each of the eight pricing reforms investigated. This is important given the acknowledged crucial role of public acceptability in determining the success of road pricing reform which was highlighted in the literature review

Although all of the elasticities are numerically small in the relative elastic range, the percentage change responses associated with specific window of change contexts defined by lifestyle and household influences, work and commuter influences transport and mobility influences, and social and environmental influences and a number of socioeconomic effects can potentially - in combination - make a difference to the support or otherwise for specific road pricing reforms. Whether this translates into changing travel behaviour in scalable and sustainable ways remains to be tested, but we have some strong clues as to what will garner support and hence be attractive to the political agenda. What we have established in this paper (and have been supported in other literature, such as in Hensher et al., 2025) is that employer incentives that encourage car use do not align with sustainability objectives, but they most likely will garner buy-in support for road pricing reform. This is a real dilemma when we want actionable change initiatives to support a switch to sustainable modes, when in fact we are likely to see a greater reinforcement of the attractiveness of the preservation of car use even under a more efficient road pricing regime.

References

- Abulibdeh, A. (2018) Implementing congestion pricing policies in a MENA Region City: Analysis of the impact on travel behaviour and equity. *Cities* 74, 196-207.
- Anas, A., Lindsey, R. (2011) Reducing Urban Road Transportation Externalities: Road Pricing in Theory and in Practice. *Review of Environmental Economics and Policy* 5, 66-88.

- Balbontin, C., Hensher, D.A. and Collins, A.T. (2017) Do familiarity and awareness influence voting intention: the case of road pricing reform? *Journal of Choice Modelling*, 25, 11-27. <https://doi.org/10.1016/j.jocm.2017.01.005>
- Baranzini, A., Carattini, S., Tesauro, L. (2021) Designing Effective and Acceptable Road Pricing Schemes: Evidence from the Geneva Congestion Charge. *Environmental and Resource Economics* 79, 417-482.
- Beck, M.J., Rose, J.M., Hensher, D.A. (2011) Behavioural responses to vehicle emissions charging. *Transportation* 38, 445-463.
- Bilbao-Ubillos, J. (2008) The costs of urban congestion: Estimation of welfare losses arising from congestion on cross-town link roads. *Transportation Research Part A* 42, 1098-1108.
- Bliemer, M.C.J., Loder, A., Zheng, Z. (2024) A novel mobility consumption theory for road user charging. *Transportation Research Part B* 189, 1-21.
- Börjesson, M., Kristoffersson, I. (2018) The Swedish congestion charges: Ten years on. *Transportation Research Part A* 107, 35-51.
- Button, K. (2020) The transition from Pigou's ideas on road pricing to their application. *Journal of the History of Economic Thought* 42 (3), 417-438.
- Cheng, Y., Watkins, S.J., Anciaes, P. (2024) What interventions are effective in reducing congestion? , *Advances in Transport Policy and Planning - Health on Move 3: The Reviews* eds Mindell, J.S., Watkins, S.J. Academic Press, Cambridge, MA 02139, United States, pp. 201-225.
- Cleland, C.L., Jones, S., Moeinaddini, M., Weir, H., Kee, F., Barry, J., Longo, A., McKeown, G., Garcia, L., Hunter, R.F. (2023) Complex interventions to reduce car use and change travel behaviour: An umbrella review. *Journal of Transport & Health* 31, 1-27.
- Cohen-Blankshtain, G., Bar-Gera, H., Shiftan, Y. (2023) Congestion pricing and positive incentives: conceptual analysis and empirical findings from Israel. *Transportation* 50, 607-633.
- Cook, C., Kreidieh, A., Vasserman, S., Allcott, H., Arora, N., Sambeek, F.v., Tomkins, A., Turkel, E. (2025) The Short-Run Effects of Congestion Pricing in New York City. *NBER Working Paper w33584*.
- Croci, E. (2016) Urban road pricing: a comparative study on the experiences of London, Stockholm and Milan. *Transportation Research Procedia* 14, 253-262.
- Dieplinger, M., Fürst, E. (2014) The acceptability of road pricing: Evidence from two studies in Vienna and four other European cities. *Transport Policy* 36, 10-18.
- Duncan, D., Graham, J. (2013) Road User Fees Instead of Fuel Taxes: The Quest for Political Acceptability. *Public Administration Review* 73, 415-426.
- Falocchio, J.C., Levinson, H.S. (2015) *Road Traffic Congestion: A Concise Guide*. Springer International Publishing, Switzerland.
- Fürst, E., Dieplinger, M. (2014) The acceptability of road pricing in Vienna: the preference patterns of car drivers. *Transportation* 41, 765-784.
- Gärling, T., Friman, M. (2018) Economic and Psychological Determinants of Ownership, Use and Changes in Use of Private Cars. *The Cambridge Handbook of Psychology and Economic Behaviour* ed Lewis, A. Cambridge University Press, pp. 567-594.
- Glaeser, E.L., Gorbach, C.S., Poterba, J.M. (2023) How Regressive Are Mobility-Related User Fees and Gasoline Taxes? *Tax Policy and the Economy* 37, 1-56.
- Glaister, S. (2018) The Smeed Report at 50: will road pricing always be 10 years away? In "Road Pricing – Technologies, economics and acceptability", edited by J. Walker, The Institution of Engineering and Technology (IET).
- Goodwin, P.B. (1996) Empirical evidence on induced traffic. *Transportation* 23, 35-54.

- Green, C. and Østli, V. (2025) The effect of battery-electric vehicle ownership on transport demand and substitution between modes, *Transportation Research Part A*, 199, 104164. <https://doi.org/10.1016/j.tra.2025.104614>
- Greene, W.H. and Hensher, D.A. (2010) *Modeling Ordered Choices: A Primer and Recent Developments*, Cambridge University Press, Cambridge
- Gu, Z., Liu, Z., Cheng, Q., Saberi, M. (2018) Congestion pricing practices and public acceptance: A review of evidence. *Case Studies on Transport Policy* 6, 94-101.
- Hensher, D.A. (1998) The imbalance between car and public transport use in urban Australia: why does it exist? *Transport Policy* 5, 193-204.
- Hensher, D.A., Ho, C. (2015) The role of perceived acceptability of alternatives in identifying and assessing choice set processing strategies in stated choice settings: The case of road pricing reform. *Transportation Research Part E* 83, 225-237.
- Hensher, D.A., Li, Z. (2013) Referendum voting in road pricing reform: A review of the evidence. *Transport Policy* 25, 186-197.
- Hensher, D.A., Mulley, C. (2014) Complementing distance based charges with discounted registration fees in the reform of road user charges: the impact for motorists and government revenue. *Transportation* 41, 697-715.
- Hensher, D.A., Rose, J.M., Collins, A.T. (2013) Understanding Buy-in for Risky Prospects - Incorporating Degree of Belief into the ex-ante Assessment of Support for Alternative Road Pricing Schemes. *Journal of Transport Economics and Policy* 47, 453-473.
- Hensher, D.A., Nelson, J.D., Wei E., Kandanaarachchi, T., Balbontin, C., Ho, C., Mulley, C. and Liu, W. (2025) Windows of change as precursors to changing travel behaviour aligned with sustainable mobility, submitted to *Transportation Research Part A*.
- Hensher, D.A., Wei, W. and Beck, M.J. (2026) Working from Home and Hybrid Work in the new era of Flexi-place and Flexi-time in *Editors: Michiel C.J. Bliemer and Corinne Mulley, Handbook on Transport and Urban Planning in the Developed World*, Edward Elgar Publishing Ltd, UK.
- Holguín-Veras, J., Sánchez-Díaz, I., Reim, B. (2016) ETC adoption, time-of-travel choice, and comprehensive policies to enhance time-of-day pricing: a stated preference investigation. *Transportation* 43, 273-299.
- Hosford, K., Firth, C., Brauer, M., Winters, M. (2021) The effects of road pricing on transportation and health equity: a scoping review. *Transport Reviews* 41, 766-787.
- Ison, S. (2018) *Road User Charging: Issues and Policies*. Routledge Taylor & Francis Group, New York.
- Jakob, M., Menendez, M. (2021) Parking pricing vs. congestion pricing: a macroscopic analysis of their impact on traffic. *Transportmetrica A: Transport Science* 17, 462-491.
- Kockelman, K.M., Kalmanje, S. (2005) Credit-based congestion pricing: a policy proposal and the public's response. *Transportation Research Part A* 39, 671-690.
- Koh, W.P., Chin, K.K. (2022) The applicability of prospect theory in examining drivers' trip decisions, in response to Electronic Road Pricing (ERP) rates adjustments - a study using travel data in Singapore *Transportation Research Part A* 155, 115-127.
- Leape, J. (2006) The London Congestion Charge. *Journal of Economic Perspectives* 20, 157-176.
- Meyer, M. D. (1999) Demand management as an element of transportation policy: using carrots and sticks to influence travel behavior, *Transportation Research Part A* 33, 575-599,
- Morton, C., Mattioli, G., Anable, J. (2021) Public acceptability towards Low Emission Zones: The role of attitudes, norms, emotions, and trust. *Transportation Research Part A* 150, 256-270.
- MRCagency (2018) *Congestion Pricing Options for Auckland: analysis of distributional effects*.
- Nilsson, A., Schuitema, G., Bergstad, C.J., Martinsson, J., Thorson, M. (2016) The road to acceptance: Attitude change before and after the implementation of a congestion tax. *Journal of Environmental Psychology* 46, 1-9.

- Olszewski, P., Xi, L. (2005) Modelling the effects of road pricing on traffic in Singapore. *Transportation Research Part A* 39, 755-772.
- Parry, I and Small, K 2005, Does Britain or the United States have the right gasoline tax, *American Economic Review* 95,1276-1289.
- Phang, S.-Y., Toh, R.S. (2004) Road Congestion Pricing in Singapore: 1975 to 2003. *Transportation Journal* 43, 16-25.
- Santos, G. (2005) Urban Congestion Charging: A Comparison between London and Singapore. *Transport Reviews* 25, 511-534.
- Santos, G., Shaffer, B. (2004) Preliminary Results of the London Congestion Charging Scheme. *Public Works Management & Policy* 9, 164-181.
- Schade, J., Schlag, B. (2003) Acceptability of urban transport pricing strategies. *Transport Research Part F* 6, 45-61.
- Schweitzer, L., Taylor, B.D. (2008) Just pricing: the distributional effects of congestion pricing and sales taxes. *Transportation* 35, 797-812.
- Selmoune, A., Cheng, Q., Wang, L., Liu, Z. (2020) Influencing Factors in Congestion Pricing Acceptability: A Literature Review. *Journal of Advanced Transportation* 2020, 1-11.
- Sen, S., Charles, M.B., Harrison, J.L. (2021) Determinants of Commute Distance in South East Queensland, Australia: Implications for Usage-based Pricing in Lower-density Urban Settings. *Urban Policy and Research* 39, 292-307.
- Sen, S., Charles, M.B., Kortt, M.A. (2019) Australian Passenger Vehicle Classification and Distance-Based Charging: Current Practices and the Way Forward. *Economic Papers* 38, 1-14.
- Simeone, C.E., Thornton, M. (2023) Cordon screen: A cordon-based congestion pricing policy evaluation method for U.S. cities. *Journal of the Air & Waste Management Association* 73, 25-39.
- Smeed, R.J. (1964) *Road pricing: the economic and technical possibilities*.
- Stanley, J.K. and Hensher, D.A. (2011) Environmental and social taxes: Reforming road pricing in Australia, *Road and Transport Research*, 20, December, 87-99.
- Torrey, W.F. (2017) Estimating the cost of congestion to the trucking industry - standardized methodology for congestion monitoring and monetization. *Transportation Research Record* 2646, 58-67.
- Washbrook, K., Haider, W., Jaccard, M. (2006) Estimating commuter mode choice: A discrete choice analysis of the impact of road pricing and parking charges. *Transportation* 33, 621-639.
- Yang, D., Kastrouni, E., Zhang, L. (2016) Equitable and progressive distance-based user charges design and evaluation of income-based mileage fees in Maryland. *Transport Policy* 47, 169-177.