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Research paper

The impact of the cost-of-living crisis on travel choices: The case of Scotland

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ABSTRACT

This study aims to identify the impact of the cost-of-living crisis on travel choices of Scottish residents. Specifically, we examine possible changes in two dimensions of travel behavior: (i) mode choice; and (ii) number of trips. Using recent data (N = 2705) from the Public Attitudes Survey (PAS) of Transport Scotland, extensive statistical modeling was conducted in order to identify which population segments are more likely to change their travel mode and reduce the number of trips they make in response to the ongoing crisis. To control for possible unobserved heterogeneity effects that may underpin these two behavioural dimensions, the Bivariate Ordered Probit (BOP) framework was employed enabling the joint modeling of these two dimensions. The survey data showed that 26.1% of the respondents changed their typical mode of travel as a means to save money, and almost 28% of the respondents have exhibited a propensity to reduce their number of trips due to rising travel costs. The results of the BOP model showed that low-income households and ethnic minorities are among the most severely affected population segments, as they are more likely to change their travel mode and reduce their amount of travel. Women, people with health issues or disabilities, millennials, and residents in rural areas of Scotland also show evidence of behavioral change in light of the cost-of-living crisis. The findings of this study highlight major inequalities in transport accessibility, which will continue to deepen and result in higher levels of transport poverty, as the cost-of-living crisis unfolds, and appropriate remedial measures are not taken by legislative and governmental Authorities.

1. Introduction

As of early 2022, the population in the United Kingdom (UK) was heavily affected by a major challenge, a global inflation crisis, which continues to have a substantial and long-standing effect on quality of life and everyday choices of people (Joseph Rowntree Foundation, 2024). The surge in global inflation can be partially attributed to the post-pandemic economic recovery and partially to the major Russia-Ukraine conflict (Béland et al., 2024). As expected, the sharp increase of inflation heavily affected living costs, primarily causing a significant drop in the purchasing power and disposable income of households. As a consequence, the inflation crisis was swiftly transformed into the most pronounced "cost-of-living crisis" (Keith Neal, 2022) since the late 70s and early 80s in the developed world (Béland et al., 2024).

Among the developed economies, the UK was one of the most severely hit by the global inflation, with the crisis affecting all size of businesses, rural and urban communities, and low-income households. In 2022, the inflation saw its highest levels over the last decades. The annual inflation rate surpassed 11% in October 2022, a 41-year record high in the UK (Harari et al., 2023). The UK economy slipped into recession in the second half of the year 2022 and then again in the second half of 2023 according to the official figures of the Office of the National Statistics (ONS, 2024). In parallel with the global inflation rise, the UK also faced additional economic challenges induced by the Brexit, which has particularly affected food price inflation and costing (Bakker et al., 2023).

The inflation crisis exacerbated the issues that the transport sector in the UK was facing because of the COVID-19 pandemic; the latter had a tremendous impact on travel choices of people, due also to an elevated risk perception of public transport users that remained – to some extent – upon the end of the COVID-19 restrictions (Downey et al., 2022). In Scotland, in late 2022 where all the COVID-19 measures had been long lifted, around 3 in 10 people were still avoiding public transport and

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using the car more compared to before the pandemic (Transport Scotland, 2022).

While some signs of a slow financial recovery emerged in 2022, the trajectory was disrupted by the cost-of-living crisis, which severely affected the pricing of all essential and non-essential services. Transport was one of the most severely affected sectors in the UK. The CPIH (Consumer Prices Index including owner occupiers' housing costs) annual inflation rate for the specific sector stood at 11.8% in 2022, causing the most pronounced impact to the inflation crisis across all sectors. During 2023, while the overall transport sector showed a decreasing contribution to the overall inflation rate, the inflation affecting passenger transport services (including public transport services, air travel and ferry services, shared mobility services and other transport options) continued to increase (at least up to October 2023, according to ONS, 2023). The rising inflation leads households to spend more on their fundamental needs, such as energy, housing, and food, and consequently, to cut back spending on other essential and non-essential services, including travel. Interestingly, one in three UK residents self-reported their willingness to reduce their travel-related expenditure due to cost-of-living concerns (ONS, 2022; Brake, 2023). The potential impact of the cost-of-living crisis on travel habits is even more pronounced on British millennials, aged between 25 and 34 years old (Deloitte & Travel Weekly, 2022). The increase of transport costs is specifically cited as a significant barrier to Britons' travel choices (ONS, 2023). Focusing on commute travel, a recent study also showed that almost a third of Britons expect their commute to become soon unaffordable if the fuel prices continue to rise (VWFS, 2022). In Scotland, four out of five people were highly concerned about the living cost crisis, whereas more than one in five struggle to afford their essential travel (Scottish Government, 2022).

During the cost-of-living crisis, the rising cost of everyday life urges people to re-consider their travel choices prompting them to either cut back on their travel frequency or to turn to more inexpensive travel modes, such as public transport or active travel. Interestingly, in Scotland and Northern Ireland, 64% of the people switched to public transport to reduce travel costs (Brake, 2023), whereas more than 4 in 10 people in Great Britain reduced the number of non-essential trips made via their personal vehicles (ONS, 2022). Although these statistics indicate that the travel habits of a significant portion of the population were affected by the cost-of-living crisis, this impact likely varies across different socio-demographic groups. Vulnerable populations, who were already disproportionately burdened by transport costs before the crisis, may have been forced to make particularly challenging adjustments to their travel habits. Rising fuel prices and increasing public transport costs may reduce the affordability of transport services, thus restricting the mobility of under-privileged groups and their overall transport accessibility. Higher travel costs often force the vulnerable population segments to reduce their journeys or rely on less efficient modes, increasing the risk of social exclusion (Martiskainen et al., 2021; Ward & Walsh, 2023). In this context, low-income households and people with disabilities may struggle to afford the costs of essential travel (Motability, 2022; Blumenberg & Agrawal, 2014), whereas rural households may face additional mobility barriers compared to urban households due to lack of adequate public transport options (Berg & Ihlström, 2019). Such significant barriers to mobility can, in turn, exacerbate accessibility inequalities, with the most severely affected socio-demographic groups facing even more constrained access to essential services, employment and education (Musselwhite, 2023).

In fact, previous evidence from across the globe suggests that in an era of economic crisis, travel habits and accessibility to essential services constitute key lifestyle aspects that are heavily affected by the reduction of the household disposable income and associated purchasing power. Such effects typically emerge through decreases in trip frequency (e.g., for shopping or leisure) or duration (Nielsen, 2015), changes in travel mode choice (e.g., shifts from car to public transport or active travel) or even shifts in the perceived importance and use of public transport (Ulfarsson et al., 2015; Burguillo et al., 2017). Interestingly, the 2008 financial crisis in Iceland led people to make fewer trips, with such reductions being more evident in non-urban segments of the population; however, low-income households were found to positively re-assess the utility of public transport (Ulfarsson et al., 2015). As a result of the long-standing Greek financial crisis, low-income households were recognized as more vulnerable to increasing travel costs, with many of these shifting from car to public transport (Papagiannakis et al., 2018). Following the 2008 financial crisis, Portuguese students experienced major shifts in their commuting patterns, primarily by using public transport more intensively (Cadima et al., 2020). Overall, a common thread identified in the literature is associated with the equity dimension of the relationship between the soaring cost-of-living and travel choices. Low-income households, younger individuals, unemployed individuals, and generally underprivileged groups of the population are more likely to suffer the travel-related consequences and in turn, experience a higher risk of transport deprivation and social exclusion (Lucas, 2012) due to limited access to affordable travel options.

Over the last few decades, the world has faced multiple periods of heightened living costs - most notably during the 1970s oil shocks, the early 1990s recession, and the 2008 global financial crisis. Although each emerged from different global conditions (such as geopolitical conflicts in the 1970s or banking collapse in 2008), the primary economic drivers – including energy price surges and constrained credit – consistently prompted households to reduce or restructure their travel behaviour. By contrast, the 2022 cost-of-living crisis in the UK is distinguished by its confluence of multiple disruptions (energy price inflation linked to the Ukraine-Russia conflict, supply-chain breakdowns intensified by Brexit, and pandemic aftershocks) and the unprecedented scale of remote/hybrid working. This evolution in work arrangements provides a new adaptation strategy largely unavailable during previous crises. Scotland offers an especially intriguing case study within the UK context. Its significant rural areas, with limited transport options, and its urban centres, capable of embracing more flexible transport modes, together can reveal how geographic and socio-economic disparities can influence the adoption of travel adaptations. The unique characteristics of the 2022 cost-of-living crisis, combined with Scotland's distinct geographic, socio-economic, and transport provision characteristics (Transport Scotland, 2020) present a valuable opportunity to comprehensively study its impact on mobility. Limited research to date has examined the effects of such crises on travel behaviour and transport accessibility in a holistic manner, particularly in terms of the socio-demographic inequalities associated with these impacts. Scotland's varied rural-urban divide, reliance on private transport in remote areas, and existing disparities in access to public transport offer a distinctive context to explore how rising costs affect different population groups and their ability to adapt.

To address the gap, the key objective of this study is to evaluate how the rapidly rising living cost affected people's travel choices of people, in terms of both amount of travel and means of transport. A full understanding of changes in both these dimensions is essential as their joint consideration may shed light on the consequences of the crisis and their contributing causes. For instance, individuals who reduce the number of trips they take and switch to cheaper travel options to control costs may have to curtail access to essential services and social activities. Others might cut back on travel but remain reliant on the same mode, indicating a lack of convenient alternatives. At the same time, some may preserve their usual travel frequency by switching to a less expensive mode, while a small group experiences no change at all, either because they have sufficient financial resilience or no realistic options beyond their current mode. Together, these scenarios highlight how economic pressures can reshape mobility patterns in ways that reinforce existing inequalities. Low-income groups, individuals living in areas with limited transport infrastructure, or those with specific travel needs can find themselves particularly vulnerable. We seek to characterize the relationship between the cost-of-living crisis and travel behaviour explicitly

considering population segments disproportionately affected by the crisis. The outcomes of the study will highlight whether and how the cost of living crisis may have intensified socio-demographic inequalities and reveal emerging sources of transport poverty and social exclusion.

2. Data

To identify the impact of the cost-of-living crisis on travel behaviour, data was drawn from the Public Attitudes Survey (PAS) of Transport Scotland (Transport Scotland, 2023). This survey has been carried out since May 2020, initially to track the impact of the COVID-19 pandemic on travel and transport in Scotland. Following the ease of the COVID-19 restrictions, this survey temporarily ceased (in November 2021), but Transport Scotland restarted it in 2022 to gain insights into key aspects of travel behaviour in the aftermath of COVID-19 and track public attitudes towards emerging, transport-related topics and issues.

PAS is a telephone-based survey, which is administered using both landline and mobile phone numbers, in line with the provisions of the General Data Protection Regulation (GDPR) and the Market Research Society (MRS) Code of Conduct. Through different waves of the PAS conducted at generally regular time intervals, different random samples of adults (over 16 years old, according to the Scottish legislation) across the entire Scotland were obtained. The sample of each survey wave is deemed overall representative of key strata of the Scottish population, as quotas were enforced during the data collection process with regards to the age, gender, region of Scotland and socio-economic classification (social grade) of the respondent's household.

In general, some questions are different from wave to wave, so that information relevant to topics high on the political agenda may be made available to policymakers. Only questions common to all three waves were used in this study, ensuring that any minor differences in the wave questionnaires did not affect the statistical analysis. Apart from questions relating to travel behaviour and transport-related attitudes of Scottish residents, the survey elicits information about the socio-economic and demographic background of the respondent (e.g., age, gender, ethnic background, household income, social grade). The questions about travel behaviour mainly concern current and pre-pandemic mode choice as well as travel frequency in light of the cost-of-living crisis. In addition, attitudes on the affordability and perceptions about the impact of transport costs on travel choices of the Scottish population are also available in the survey data. The survey included questions about activity patterns and habits of the respondents before and after the COVID-19 pandemic.

In this study, data from the three most recent survey waves (22, 23 and 24) were compiled leading to a total sample of 3021 responses. The timeline of the different survey waves along with information about the sample size (N) and inflation trajectory during the data collection periods is provided in Table 1.

Due to missing or partial information, the final sample used for statistical analysis consists of 2705 responses. 48% of the respondents were identified as males, where 51% of the sample were identified as females. Both percentages are in accordance with the gender distribution of the Scottish population (National Records of Scotland, 2022).

Table 1
Data collection periods and evolution of inflation over time in the UK.

Survey wave	N	Data collection period	UK Consumer Prices Index (CPI)[a]	Inflation rate for transport services[a]
Wave 22	878	16 May – June 1, 2022	9.10%	13.80%
Wave 23	913	13 July-26 July 2022	10.10%	14.80%
Wave 24	913	21 September – October 9, 2022	11.10%	8.90%

[a] Source: Office for National Statistics (ONS).

76.4% of the sample consisted of respondents aged between 16 and 64 years, whereas 20.6% of the respondents were 65 years or older – these statistics also closely resemble the age distribution of the Scottish population (National Records of Scotland, 2022).

Two verbatim questions-statements of the survey, which provide insights into the self-reported implications of the cost-of-living crisis on travel choices, serve as the key dependent variables of the statistical analysis. These are:

(i) I have changed the mode of transport I use to save money.
(ii) I am no longer able to make as many journeys as I did due to travel costs.

For both questions, which were included in all three survey waves, the respondents were asked to rate their level of agreement on a 5-point Likert scale (ranging from 1: Strongly disagree to 5: Strongly agree). Fig. 1A shows the distributions of the responses to the two questions, presented individually.

Fig. 1B shows the joint distribution of the responses to the two questions, which allows a quick identification of patterns not evident in the individual distributions (e.g., the proportion of respondents that agreed with both questions). The length of the bar in Fig. 1B represents the number of responses corresponding to each Likert-scale outcome of the variable on the vertical axis, "no longer able to make as many journeys as I did due to travel costs". Each bar is divided into five segments, each shaded in a different tones, representing the outcome of the variable on the horizontal axis: "change of transport mode to save money". The total proportion of the sample associated with each outcome of the change of transport mode variable can be calculated by summing all the tone-specific percentages. For example, the sum of the percentages of the darkest tone is the total proportion of the sample that answered "Strongly agree" to the question about change of travel mode. The percentage shown within each coloured bar segment indicates the proportion of the sample associated with a particular combination of answers. For instance, 8.06% of the sample strongly agreed with the statements posed in both questions, while 22.37% of the sample strongly disagreed with both statements.

Overall, it can be inferred that 26.10% of the respondents strongly or somewhat agreed with the statement about the change of mode of transport, whereas almost 38% of the respondents provided evidence (through strong or slight agreement) on their inability to continue making the same number of trips as before, due to the increased travel costs. More than 15% of the respondents have reported both a change of transport mode and a tendency to make fewer journeys. This is the sub-sample whose travel habits have been disrupted the most by the cost-of-living crisis. Such a disruption may be due to (a combination of) different reasons: on the one side, it may be due to fact that the mandatory expenses of the people in this group have increased the most due to inflation, leaving them with a quite lower budget to spend on travel. On the other side, the reduction may indicate a greater flexibility of travel choices, possibly linked to a large prevalence of non-essential travel before the cost-of-living crisis.

In contrast, almost four in ten respondents (37.92%) do not seem to have altered their travel behavior, as neither their mode choice nor their ability to maintain the same travel patterns has changed. Overall, among those making behavioural changes to address the implications of crisis, the reduction of trips is found to be more prevalent compared to the change of transport mode. This disparity between these two behavioral aspects may not be a matter of choice, but – similar to what discussed above – the result of the availability of viable transport alternatives individuals have access to. The statistical modeling of both aspects will shed light on the factors determining the likelihood of each specific behavioral change.

For the estimation of the statistical model, three key categories of possible independent variables were considered in line with previous empirical evidence on travel behaviour during economic hardship

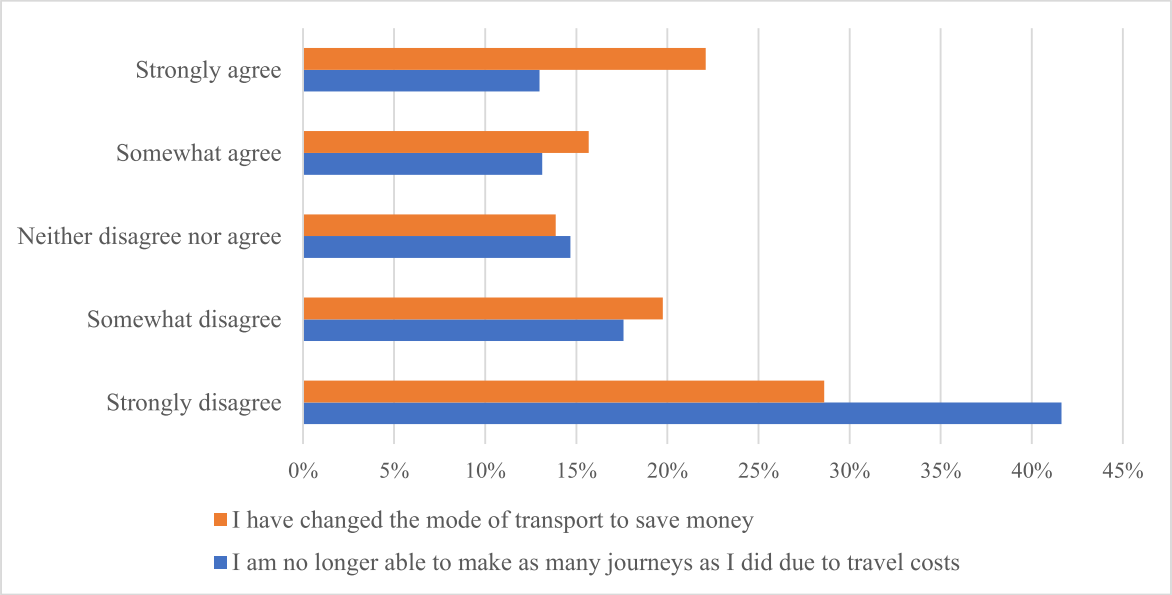

Fig. 1A. Distribution of responses to key survey questions (N = 2705).

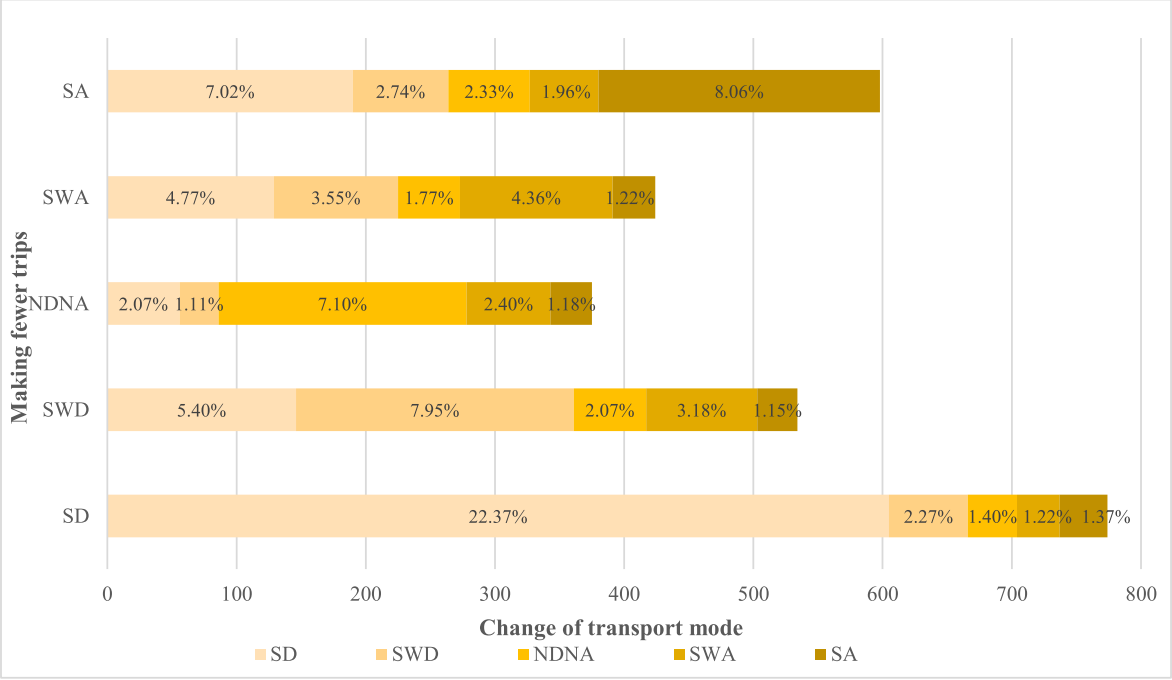

Fig. 1B. Joint distribution of key survey questions across all response outcomes (N = 2705)
SD: Strongly Disagree; SWD: Somewhat Disagree; NDNA: Neither Disagree Nor Agree; SWA: Somewhat Agree; SA: Strongly Agree.

periods:

- Socio-demographic characteristics (e.g., gender, age, household income, ethnic background, disability status and others)
- Travel behavior and access to travel modes (e.g. main mode of travel, household access to car/bicycle, mode choice changes in light of the COVID-19 pandemic and others)
- Spatial and temporal traits (e.g., region of Scotland, survey waves, inflation indices)

A wide range of variables was tested for inclusion in the statistical model. In addition to the original variables derived from the survey, several transformations and interactions were examined during the modelling process. A comprehensive list of all variables investigated, along with their distributions, is provided in the Appendix (Table A1). In this Table, variables and their possible values are presented as specified in the questionnaire. Following extensive modelling efforts, a set of key variables was identified as having a statistically significant impact on both dependent variables. The descriptive statistics for the dependent and independent variables included in the final model are summarised in Table 2. The variables in Table 2 were derived through transformation from those in Table A1 as presented in the "Variable description" column.

To investigate the relationships between key independent variables

Table 2
Descriptive statistics of key variables (N = 2705).

Variable coding	Variable description	Mean/ Percentage	Std. Dev.
MODCH	"I have changed the mode of transport I use to save money" (5-point Likert scale: Strongly disagree to Strongly agree)	1.373	1.452
TRIPRED	"I am no longer able to make as many journeys as I did due to travel costs" (5-point Likert scale: Strongly disagree to Strongly agree)	1.827	1.540
FEMALE	Gender (1 if female, 0 otherwise)	51.39%	–
MILLEN	Millennial (1 if the respondent belongs to the millennial generation, 0 otherwise)	32.98%	–
BOOMER	Baby boomer (1 if the respondent belongs to the baby boomer generation, 0 otherwise)	30.98%	–
LOWINC	Low-income household (if the annual income of the respondent's household is less than £20,000, 0 otherwise)	7.87%	–
ABGRAD	AB Social grade (1 if the Household Reference Person works in a higher & intermediate managerial, administrative, or professional role, 0 otherwise)	26.65%	–
MIXED	Ethnic background (1 if ethnic minority group – i.e., any mixed, Asian, or Black background, 0 otherwise)	3.25%	–
DISAB	Health problem or disability (1 if day-to-day activities are limited a lot due to a health problem or disability, 0 otherwise)	11.72%	–
ACTRAV	Active travel (1 if walking/cycling is among the respondent's main modes of travel, 0 otherwise)	55.93%	–
PUBTRA	Public transport use (1 if bus/train/ metro/tram is among the respondent's main modes of travel, 0 otherwise)	38.23%	–
BICYAC	Bicycle access (1 if the respondent's household has access to a bicycle, 0 otherwise)	51.61%	–
CARBUS	Switch from car to bus (1 if the respondent travels less by car and more by bus compared to before the pandemic, 0 otherwise)	3.51%	–
CARWALK	Switch from car to walking (1 if the respondent travels less by car and more by walking compared to before the pandemic, 0 otherwise)	13.54%	–
CBELT	Scotland main conurbations (1 if the respondent lives in Edinburgh and Southeast Scotland or in Glasgow City, 0 otherwise)	48.13%	–
HIGISL	Highlands and Islands (1 if the respondent lives in Highlands and Islands, 0 otherwise)	5.66%	–
WAVE23	Survey wave (1 if 23, 0 otherwise)	33.47%	–

(as well as the dependent variables) and to check for potential multi-collinearity issues, a correlation analysis was carried out. In line with standard practice (Greene, 2018), polychoric correlation was estimated for the pair of the dependent variables, when these were both ordinal, whereas for pairs of binary variables, tetrachoric correlation was computed. The diagonal matrix with the correlation coefficients is provided in Table A2 of the Appendix. All the correlation coefficients have values lower than 0.5; the latter constitutes a strict cutoff value for detecting multicollinearity issues according to Vatcheva et al. (2016). The relatively low correlations between most regressors suggest that there are no significant multi-collinearity issues between the exogenous variables included in the model.

3. Methodology

Due to their Likert-scale formulation, the dependent variables (i.e., the key survey questions) are ordered in nature, so to account for the inherent hierarchy of their outcomes, the ordered probit framework was employed for statistical modeling. The ordered probit model is formulated through a latent variable, y^*, which, for each respondent i, is defined as (Olowosegun et al., 2022):

$$y_i^* = \boldsymbol{\beta}\mathbf{X}_i + \varepsilon_i \tag{1}$$

Where, $\mathbf{X}$ represents a vector of independent variables affecting the dependent variable, $\boldsymbol{\beta}$ is a vector of coefficients (parameters) associated with $\mathbf{X}$, and ε denotes an error term considered to vary according to the standard normal distribution (mean zero and variance one). The latent variable defines the probability of the outcome k for each individual i according to the equation:

$$P_i(k) = \Phi(\mu_k - \boldsymbol{\beta}\mathbf{X}_i) - \Phi(\mu_{k-1} - \boldsymbol{\beta}\mathbf{X}_i), k\epsilon[0, Z-1] \tag{2}$$

Where Φ is the cumulative function of the standard normal distribution, μ_k are estimable parameters, and Z the number of possible outcomes. Following the formulation of Washington et al. (2020), it is assumed that the μ_0 (i.e., the first threshold) takes a zero value, therefore K-2 thresholds constitute estimable parameters of the model, where K is the total number of outcomes of the dependent variable. The parameters $\boldsymbol{\beta}$ and μ_k are also estimated so that they maximise the combined likelihood of observing all the measured outcomes.

The dependent variables capture the reported impact of the rising costs on different, but closely related aspects of travel behaviour (i.e., Mode Choice - MC and Number of Journeys - JN). These behaviours are intrinsically interconnected, as individuals' decisions about which travel mode to use often influence, and are influenced by, the frequency or number of journeys they undertake. Clearly, there are likely to be common unobserved characteristics – such as individual attitudes toward cost-saving, accessibility of alternative modes, lifestyle constraints, or unmeasured socio-demographic factors – that simultaneously shape responses about both behaviours. For instance, someone experiencing financial strain might cut back on travel and rely more on public transport. Such unobserved effects could cause correlation of the error terms of the two latent functions. The estimation of separate, univariate ordered probit models for each dependent variable would not allow for considering the cross-equation error term correlation (Washington et al., 2020), potentially leading to biased parameter estimates. To overcome this problem, the Bivariate Ordered Probit (BOP) framework is employed, which instead models the two dependent variables jointly, accounting, at the same time, for the possible correlation of the error terms (Washington et al., 2020). The model is formulated as:

$$\begin{aligned} y_{i,MC}{}^* &= \boldsymbol{\beta}_{i,MC}\mathbf{X}_{i,MC} + \varepsilon_{i,MC} \\ y_{i,JN}{}^* &= \boldsymbol{\beta}_{i,JN}\mathbf{X}_{i,JN} + \varepsilon_{i,JN} \end{aligned} \tag{3}$$

Where, $y_{i,MC}{}^*$ and $y_{i,JN}{}^*$ are the latent variables corresponding to the two jointly-modeled dependent variables (i.e., change of transport mode & tendency to make fewer journeys) and all other terms are as previously denoted.

According to Washington et al. (2020), the error terms of the two dependent variables follow the bivariate standard normal distribution. The cross-equation correlation of the error terms is an estimable parameter of the model, defined as (Tsavdari et al., 2022; Washington et al., 2020):

$$\begin{pmatrix} \varepsilon_{i,1} \\ \varepsilon_{i,2} \end{pmatrix} \sim \mathcal{N}\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right] \tag{4}$$

Where, ρ represents the cross-equation error term correlation, and $\mathcal{N}$ is the bivariate normal distribution. The estimation of the bivariate

ordered probit model was carried out using a full information maximum likelihood estimation approach (Washington et al., 2020).

To measure the impact of each independent variable on the likelihood of each outcome of the dependent variables, marginal effects were also calculated. Given that the estimated model consists only of indicator variables (see the "Results and Discussion" section for further details), the marginal effects quantify the change in the likelihood of the dependent variable due to a change in the value of an independent variable from zero to one. In the context of the ordered probit framework, marginal effects also illustrate the actual effect of the independent variables on the intermediate outcomes of the dependent variables (i.e., somewhat disagree; neither disagree, nor agree; somewhat agree), which cannot be readily provided by the parameter estimates of the model (Semple et al., 2023).

4. Results and discussion

The estimation results of the BOP model, along with the descriptive statistics of key variables are presented in Table 3, whereas the marginal effects of the model's independent variables are presented in Table 4. In general, all possible exogenous factors (and several interactions) that could potentially affect the dependent variables were trialled, with the selected model providing the best statistical fit in terms of three key goodness-of-fit metrics: (i) log-likelihood at convergence; (ii) McFadden pseudo-R^2; and (iii) Akaike Information Criterion (AIC). The factors investigated throughout the modelling course are provided in the Appendix (Table A1) along with their key distributions.

All independent variables in the selected model were detected to exert statistically significant effects, with the vast majority being significant at a greater than 95% level of confidence. A positive sign of the coefficient suggests an increase in the likelihood of the "Strongly Agree" outcome (i.e., denotes a stronger reported effect of the cost-of-living crisis on travel choices), whereas a negative sign implies an increase in the likelihood of the "Strongly Disagree" outcome. Likelihood Ratio Tests (LRTs) were conducted to confirm not only the significance of the BOP model compared to the null model (with zero variables), but also the superiority of the BOP against its univariate counterparts (i.e., a univariate ordered probit model for change of transport mode and a univariate ordered probit model for the tendency to make fewer journeys).

Starting with the key socio-demographic factors, the model results suggest low-income households as one of the most severely affected population segments. Table 3 shows that individuals from low-income households (with annual income less than £20,000) are more likely (compared to households of higher income) to have changed their mode of travel to save money. The same population segment is also more likely to make fewer trips due to travel costs. Interestingly, the computed marginal effects reveal that the low-income variable has the strongest effect in the model component about the tendency towards making fewer trips. Specifically, Table 4 shows that if the respondent is a member of a low-income household, the likelihood of "strongly agree" or "somewhat agree" outcomes increases collectively by 0.119.

The strong evidence provided by both model coefficients and marginal effects highlight the significant vulnerability of low-income households to rising living costs, as they may be compelled to cut back spending on services like transport in order to cover fundamental needs, such as food, energy and housing costs. Due to the inflation rates and their lower financial resilience, the proportion of their budget allocated to essential travel is already higher compared to financially more resilient socio-demographic groups (Gebremeskel et al., 2023; Scottish Government, 2022). Therefore, the financial crisis has forced them to drastically modify their travel habits in an effort to cut back larger portions of their travel budget compared to other income strata. This trend is also identified by recent data from the Office of National Statistics in the UK (ONS, 2022) showing that the proportion of households that reduce the number of non-essential journeys made using their

Table 3
Estimation results of the BOP model.

Variable description		Change of travel mode		Making fewer trips	
		Coefficient	t-stat	Coefficient	t-stat
Constant		−0.769	−3.02	0.436	10.84
Socio-demographic characteristics	FEMALE (1 if female, 0 otherwise)	–	–	0.181	4.87
	MILLEN (1 if the respondent belongs to the millennial generation, 0 otherwise)	0.092	2.19	–	–
	BOOMER (1 if the respondent belongs to the baby boomer generation, 0 otherwise)	–	–	−0.092	−2.23
	LOWINC (if the annual income of the respondent's household is less than £20,000, 0 otherwise)	0.219	3.03	0.315	4.40
	ABGRAD (1 if the Household Reference Person works in a higher & intermediate managerial, administrative, or professional role, 0 otherwise)	–	–	−0.195	−4.46
	MIXED (1 if ethnic minority group – i.e., any mixed, Asian, or Black background, 0 otherwise)	0.330	2.77	0.241	1.95
	DISAB (1 if respondent's day-to-day activities are limited a lot due to a health problem or disability, 0 otherwise)	–	–	0.243	4.49
Current use and access to travel modes	ACTRAV (1 if walking/cycling is among the respondent's main modes of travel, 0 otherwise)	0.292	7.23	–	–
	PUBTRA (1 if bus/train/metro/tram is among the respondent's main modes of travel, 0 otherwise)	0.327	7.76	–	–
	BICYAC (1 if the respondent's household has access to a bicycle, 0 otherwise)	0.104	2.70	–	–
	CARBUS (1 if the respondent travels less by car and more by bus compared to before the pandemic, 0 otherwise)	0.327	2.77	–	–
	CARWALK (1 if the respondent travels less by car and more by walking compared to before the pandemic, 0 otherwise)	0.267	3.78	0.116	1.83
Spatial & temporal traits	CBELT (1 if the respondent lives in Edinburgh and Southeast Scotland or in Glasgow City, 0 otherwise)	0.064	1.65	–	–
	HIGISL (1 if the respondent lives in Highlands and Islands, 0 otherwise)	–	–	0.184	2.36
	CPI (Consumer Price Index) across all survey waves	5.042	2.03	–	–
	WAVE23 (1 if survey wave 23, 0 otherwise)	–	–	0.095	2.40
Thresholds & correlation	μ1	0.462	22.60	0.545	24.11
	μ2	0.884	32.33	0.895	32.61
	μ3	1.396	39.10	1.343	40.23
	Cross equation error term correlation (ρ)	0.519	31.52		
Goodness-of-fit metrics	Number of observations	2705			
	Log-likelihood at zero [LL(0)]	−8396.740			
	Log-likelihood at convergence [LL(**β**)]	−7824.133			
	Akaike Information Criterion (AIC)	15,704			

*A Likelihood Ratio Test (LRT) was conducted for this variable and the results showed that the variable is statistically significant at a 0.90 level of confidence.

Table 4
Marginal effects of the variables included in the BOP model.

Variable description		Change of travel mode					Making fewer trips				
		SD	SWD	NAND	SWA	SA	SD	SWD	NAND	SWA	SA
Socio-demographic characteristics	FEMALE (1 if female, 0 otherwise)	–	–	–	–	–	−0.060	−0.011	0.003	0.015	0.052
	MILLEN (1 if the respondent belongs to the millennial generation, 0 otherwise)	−0.052	0.000	0.008	0.015	0.026	–	–	–	–	–
	BOOMER (1 if the respondent belongs to the baby boomer generation, 0 otherwise)	–	–	–	–	–	0.043	0.007	−0.003	−0.011	−0.037
	LOWINC (if the annual income of the respondent's household is less than £20,000, 0 otherwise)	−0.079	−0.003	0.012	0.025	0.045	−0.094	−0.024	0.000	0.021	0.098
	ABGRAD (1 if the Household Reference Person works in a higher & intermediate managerial, administrative, or professional role, 0 otherwise)	–	–	–	–	–	0.080	0.012	−0.006	−0.021	−0.065
	MIXED (1 if ethnic minority group (any mixed, Asian, or Black background), 0 otherwise	−0.123	−0.009	0.016	0.038	0.078	−0.075	−0.019	0.001	0.017	0.076
	DISAB (1 if day-to-day activities are limited a lot due to a health problem or disability, 0 otherwise)	–	–	–	–	–	−0.093	−0.023	0.001	0.021	0.094
Use and access to travel modes	ACTRAV (1 if walking/cycling is among the respondent's main modes of travel, 0 otherwise)	−0.123	0.002	0.023	0.038	0.061	–	–	–	–	–
	PUBTRA (1 if bus/train/metro/tram is among the respondent's main modes of travel, 0 otherwise)	−0.119	−0.002	0.020	0.037	0.063	–	–	–	–	–
	BICYAC (1 if the respondent's household has access to a bicycle, 0 otherwise)	−0.039	0.000	0.007	0.012	0.020	–	–	–	–	–
	CARBUS (1 if the respondent travels less by car and more by bus compared to before the pandemic, 0 otherwise)	−0.120	−0.008	0.016	0.036	0.072	–	–	–	–	–
	CARWALK (1 if the respondent travels less by car and more by walking compared to before the pandemic, 0 otherwise)	−0.102	−0.004	0.015	0.032	0.059	−0.035	−0.007	0.001	0.009	0.032
Spatial & temporal characteristics	CBELT (1 if the respondent lives in Edinburgh and Southeast Scotland or in the Glasgow City, 0 otherwise)	−0.029	0.000	0.005	0.009	0.015	–	–	–	–	–
	HIGISL (1 if the respondent lives in Highlands and Islands, 0 otherwise)	–	–	–	–	–	−0.051	−0.012	0.001	0.012	0.049
	CPI (Consumer Price Index) across all survey waves	−2.471	0.009	0.443	0.772	1.247	–	–	–	–	–
	WAVE23 (1 if 23, 0 otherwise)	–	–	–	–	–	−0.037	−0.006	0.002	0.010	0.031

own vehicle is significantly higher for lower incomes. It should be noted that households facing financial pressures are typically inclined to use less their personal vehicles, with this behaviour being evidenced even before the onset of the cost-of-living crisis (Department for Transport, 2022). This population segment is expected to turn towards more affordable travel options, such as public transport and active transport means.

As opposed to low-income households, the travel behaviour of respondents belonging to the social grade A or B does not seem to be affected by the rising travel costs. The social grade is a socio-demographic classification used in the UK exclusively based on the type of occupation of the Household Reference Person, with AB reflecting higher & intermediate managerial, administrative, and professional occupations. As shown in Table 3, these individuals are less likely to reduce their number of trips. This is an anticipated outcome as recent evidence (VisitBritain, 2022) has shown that social grade AB has been the least affected by the cost-of-living crisis compared to all other grades (C1, C2, DE). Previous evidence has shown that this social grade may rely less on physical travel for work purposes, due to higher involvement in teleworking activities – this trend was strongly observed during the pandemic (Semple et al., 2023). Interestingly, 54% of respondents in the AB social grade reported working from home more frequently than before the pandemic.

The impact of the cost-of-living crisis on travel behavior is also identified to vary across different generations. Specifically, the need of millennials (born between 1981 and 1996) to change their mode of travel in order to reduce their transport-related expenditure is clearly documented in the results of the BOP model. In contrast, baby boomers (born between 1946 and 1964) are less likely to reduce the number of trips they make. The rising living cost constitutes a top concern for millennials (Deloitte, 2023) and given their lower dependence on car-oriented lifestyles (Delbosc et al., 2019) compared to earlier generations, they may be more willing (and able) to switch to affordable travel modes (e.g., active travel, public transport, or shared mobility services), especially if the latter are considered as environmentally sustainable. According to recent evidence, baby boomers in the UK and abroad are less affected by the rising inflation compared to other generational strata (Bank of America, 2023; DJS Research, 2023), and as expected, they are more reluctant to make lifestyle changes and reduce their mobility patterns. These results reveal generational disparities in the impact of the cost-of-living crisis, which need to be carefully addressed in the future.

Table 2 shows that females are also more likely to reduce the number of trips compared to males, due to rising travel costs. According to a recent study of the Scottish Government, women are more exposed than men to the growing burden of the living cost, mainly due to their lower wages or savings, more caring responsibilities and their potential involvement in economic sectors most severely affected by the crisis (Scottish Government, 2022). The propensity of female respondents towards fewer trips may be attributed either to the crisis-led increase of the cost of owing or driving a car, which makes the car use unaffordable for a major portion of women, or their lack of access to adequate public transport services, especially in remote or rural areas of Scotland (Engender, 2022).

Ethnic minorities are also detected as one of the most vulnerable groups, with respondents of any mixed, Asian, or Black background being more likely to have changed their mode of travel since the onset of the cost-of-living crisis. The same population segment is also more likely to reduce the overall number of trips made. Notably, the specific variable has a notable impact on the model component about change of travel model, with Table 4 showing that for individuals of this group, the likelihood of the "somewhat agree" and "strongly agree" outcome increases by 0.116. These results re-iterate the widely documented vulnerability of minority ethnic households, not only to the cost-of-living crisis (as recently documented by the Scottish Government, 2022), but also to both energy and transport poverty (Martiskainen et al., 2021). Due to their relatively higher likelihood to face financial hardships in combination with soaring inflation, minority groups may need to spend higher proportions of their income for their essential needs, thus cutting back expenses for travel. In addition, some minority groups may be also living in areas of lower housing costs where the provision of transport services may not be adequate (Martiskainen et al., 2021), above all for non-vehicle owners, limiting considerably their mobility options and paving the way for social exclusion.

Another socio-demographic group that is disproportionately affected by the cost-of-living crisis are those with a health problem or disability. The latter are shown to be more inclined to reduce the amount of travel due to rising costs. These individuals typically face significant challenges in terms of transport accessibility, and as a result, it is estimated that they make 38% fewer trips than individuals without disabilities, even before the onset of the crisis (Motability, 2022). This accessibility gap is likely to be exacerbated by the living cost soar because households with members with a disability need to overspend on personal transport (33% according to the latest figures), mainly due to accessibility issues of public transport (Botterill, 2019) and active travel infrastructure.

The results of the BOP models also suggest that those currently using public transport or active travel means are more likely to have recently changed their mode of travel in an effort to reduce their transport-related expenses. This result reflects the eagerness of individuals to identify and use more affordable travel options and it is also backed up by a recent survey across the entire UK (Brake, 2023) showing that 72% of respondents opted for cycling and walking for short trips they used to make by their personal car or public transport before the onset of the crisis. Particularly, in Scotland, 64% of the respondents switched to public transport; that switch was deliberately made as a cost-saving measure. These findings show that the rising transport costs could potentially serve as an accelerator of behavioural change if these changes in travel choices are stabilised by means of targeted policy interventions. Policymakers should take into account these trends while designing policies and investments to ensure equitable provision of public transport services and active travel infrastructure. Similarly, members of households with access to a bicycle are also associated with a greater likelihood of mode choice shift, possibly towards cycling. For these individuals, opting for active travel is even more feasible, as there is direct access to the mode.

In the same context of the impact of current travel behaviour, the model provides valuable insights into how individuals who reduced their car use after the onset of the COVID-19 pandemic responded to rising living costs. Table 3 reveals that individuals who used bus more compared to car post-pandemic were more likely to report a change in mode choice. Additionally, those who increased walking and relied less on cars compared to pre-pandemic levels were more likely to report both a reduction in the number of trips and a change in mode choice. These findings suggest that individuals who transitioned to a more car-free lifestyle during the pandemic have either the willingness or the necessity, and the possibility to adjust their mobility patterns in response to household financial pressures. Even though these results cannot reveal directional shifts in mode choice due to the cost-of-living crisis, they do provide some preliminary indications into overall tendencies in travel mode shifts.

Focusing on location-specific characteristics, higher likelihood of mode choice change is also observed for residents in Edinburgh, Glasgow and Southeast Scotland, as shown in Table 3. These areas are located in the Central Belt, which is more densely populated than the rest of Scotland (the Central Belt hosts around the 70% of the Scottish population in about 15% of the area of the country), in particular the two largest urban areas, Glasgow and Edinburgh. In these regions, affordable travel options (e.g., public transport, shared mobility services or active travel) are overall more widely available compared to rural areas. Therefore, the observed mode shift aimed at reducing travel costs in urban settings may have been realised by switching to these more affordable modes (Botzoris, 2020; Jain et al., 2014). This shift is generally more feasible in urban areas due to the greater provision and quality of transport services and the more mixed land use. Such a behavioral shift may not be that feasible for dwellers of more remote areas. In fact, the BOP results show that residents of the Highlands and Islands are more prone to a reduction of their travel frequency, because of the soaring travel costs. Highlands and Islands is a representative example of a rural and remote area of Scotland, where the fuel poverty levels are among the highest in the country (Scottish Government, 2021). Rural and island households in Scotland tend to spend more for transport services (compared to their urban counterparts) due to higher fuel prices, the longer distances they need to cover as well as the limited provision of public transport (Scottish Government, 2021). The latter constitutes a major challenge for rural residents, as the available alternatives to car use are extremely limited, thus prompting them to respond to the surge in fuel/energy costs by making less trips and effectively constraining their mobility patterns.

As shown in Table 3, a positive relationship was identified between the CPI and the likelihood of respondents changing their travel mode; in other words, as CPI increases, so does the probability of individuals reconsidering their mode of travel. This finding aligns with previous literature on price elasticities in transportation (Goodwin et al., 2004; Graham & Glaister, 2004; Wardman, 2022). As earlier noted, inflationary pressures prompt households to re-evaluate their expenditures, prioritise essential needs, and explore transportation alternatives that offer cost savings. This behaviour is consistent with a key principle of economic theory, which suggests that during periods of high inflation, cost efficiency becomes a critical factor in individual decision-making (Blanchard & Sheen, 2013). It is also worth noting that the inflation rate specifically for transportation services was also tested as a potential influencing factor, but its impact was found to be statistically insignificant in both model components.

Lastly, the fluid economic environment, proxied by the timing of the survey waves, was also found to be associated with respondents' behavioural changes. Specifically, those that were interviewed during the survey wave 23 (conducted in July 2022) were more likely to report a reduction in the number of trips compared to those surveyed in the other two waves (22 and 24). As shown in Table 1, the inflation rate for transport services during survey wave 23 was the highest in the entire analysis period, indicating significant financial pressure on households to sustain their usual mobility patterns. This financial strain may have compelled some households to reduce their journeys, particularly those deemed non-essential. Given that the CPI is already included as an independent variable in the BOP model, the wave 23 variable might also be capturing non-linear effects of overall inflation (see, also, Washington et al., 2020, about the capability of temporal, dummy variables to capture non-linear effects), particularly during periods marked by significant transport-related inflation. However, this observation warrants further investigation using more disaggregate data on the trends of both general and sector-specific inflation rates.

Table 3 also shows that the cross-equation error term correlation is statistically significant (at a 99% level of confidence). That means the error terms corresponding to the two dependent variables of the BOP model are indeed correlated, thus providing statistical evidence on the suitability of the bivariate modeling technique. The significance of the

correlation proves that the unobserved characteristics captured by the error terms indeed share systematic similarities in the way they affect both dependent variables. Such systematic similarities of the unobserved characteristics have been accounted for throughout the estimation of the bivariate probit model, and such, the parameter estimates of the independent variables are more robust (Ahmed et al., 2023). The positive sign of the correlation coefficient implies that the common unobserved characteristics affect both dependent variables in the same direction (Washington et al., 2020); in other words, unobserved characteristics that favor a change in the travel mode also favor an increase in the propensity towards fewer trips, and vice versa.

5. Policy implications and conclusions

In this study, we sought to understand how and to what extent the cost-of-living crisis has affected the travel behaviour and accessibility of Scottish residents by focusing on two fundamental dimensions: mode choice and number of trips. To that end, data from several waves of the Public Attitudes Survey of Transport Scotland were used and statistically analysed. To account for the potential impact of shared unobserved effects between these inter-related behavioral dimensions, a Bivariate Ordered Probit (BOP) model was estimated, which allowed for the joint modeling of both behavioural aspects within an integrated estimation framework. The descriptive analysis of the data showed that more than one in four respondents reported a change in their main travel mode, whereas almost four in ten mentioned they are no longer able to make as many trips as before the onset of the cost-of-living crisis.

The BOP results suggested that low-income households and ethnic minority groups are among the most severely affected population segments of the crisis, as they are both associated with a higher propensity towards a travel mode change and towards making fewer trips in response to the rising costs. Females and those with a health problem or disability are more likely to reduce their amount of traveling due to the crisis, whereas baby boomers and respondents engaged in higher & intermediate managerial, administrative, and professional occupations are identified as the most resilient socio-demographic groups. Millennials and residents of the major urban areas of Scotland show a higher tendency to change their mode of travel, whereas for the residents of Highlands and Islands, the rising travel cost prompt them to reduce their amount of trips.

The findings of this study shed light on major inequalities as to the impact of the cost-of-living crisis on travel behaviour, and overall transport accessibility. These inequalities are not new, but they are further deepening in light of the crisis. In a nutshell, low-income households, ethnic minorities, disabled people, younger individuals and females, as well as rural households are disproportionally affected by the crisis (compared to other socio-demographic groups). If remedial measures are not taken soon by the central government and local Authorities, these inequalities will further deepen, putting the aforementioned groups at greater risk of transport poverty and, in turn, social exclusion. Addressing these inequalities requires proactive state interventions, targeted financial support and subsidies, especially in rural and under-deserved areas.

Such policy interventions should focus on ensuring affordable and accessible travel options for those at higher risk through concessionary ticket schemes and fare caps for public transport services. During times of economic hardship, public transport should be leading the way towards more affordable, but sustainable travel, especially for the underprivileged groups; as such, higher public investment should be directed towards the upgrade of the public transport provision and improvement of their quality of service (Olowosegun et al., 2021), especially in rural areas, where the services are quite sparse. In these areas, the public transport services have been strongly hit by the COVID-19 pandemic, and the lack of infrastructure and public investments may further hamper the recovery of the sector (Downey et al., 2022). To avoid a further deepening of transport inequalities in rural areas, public transport services should be supplemented by formal and informal shared mobility services. The use of these services could be further encouraged through digital platforms, Mobility-as-a-Service (MaaS) schemes, and user incentives. Local and governmental authorities should support the role of shared mobility services as feeders to key public transport in rural areas by providing subsidies or other financial incentives. Without such support, the pricing and limited coverage of shared mobility services in non-urban areas could serve as significant barriers for rural dwellers.

Improvement of provision for public transport and shared mobility services should be also prioritised in deprived suburbs of major urban areas, where the most disadvantaged groups face the major mobility barriers. As suggested by the findings of the study, active travel may serve as an affordable and sustainable alternative to motorised modes (either by users' deliberate choice or not); hence, it is suggested that investments on active travel infrastructure (e.g., cycle and pedestrian paths, segregated routes) should be intensified. Lastly, community transport programs that can be tailored to the needs of those with disabilities or carers or those located in remote areas can take the pressure off the budget of socio-demographic groups that a priori need to pay extra costs to accommodate their special travel requirements.

Overall, the prioritisation of public transport and active travel in public agenda may not only help narrow the inequalities on transport accessibility induced by the cost-of-living crisis, but it may also facilitate the achievement of the net-zero target in the transport sector, which is clearly documented in Scotland's National Transport Strategy (Transport Scotland, 2020). In that way, the threat posed by the economic crisis can be reversed into an opportunity for impactful climate action and equitable mobility for all.

The data available for our analysis clearly suggests that the cost-of-living crisis has impacted travel behaviour and that such impacts are not distributed uniformly across the population, which is alarming enough to require careful attention from policy makers and all central/local Authorities. However, the dataset we used does not provide information on the extent of the change, on the type of trips affected, and on the full spectrum of the modal shift. Further research is required to clarify these aspects and so fine-tune and prioritise interventions. In addition, further work is needed to investigate how targeted state support mechanisms could further support the mobility for vulnerable groups that are at risk of social exclusion and secure their fair access to essential services and opportunities. From a methodological perspective, future research could benefit significantly from employing copula-based multivariate models (Bhat & Eluru, 2009; Seyedabrishami & Izadi, 2019). These models are particularly adept at capturing and modelling complex dependence structures (Meloni et al., 2011; Irannezhad et al., 2017), which are crucial for understanding the intricate interrelationships that underpin various dimensions of travel behaviour, especially in light of the cost-of-living crisis.

CRediT authorship contribution statement

Grigorios Fountas: Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Achille Fonzone:** Writing – review & editing, Validation, Methodology, Investigation, Conceptualization. **Adebola Olowosegun:** Writing – review & editing, Investigation, Formal analysis, Data curation.

Declaration of competing interest

Declarations of interest: none.

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APPENDIX

Table A1
A synopsis of the variables of the entire sample explored in the statistical analysis (N = 3021)

Variable	Description	Outcomes	Percentage (%)
Changed mode of transport to save money	I have changed the mode of transport I use to save money	Strongly disagree	41.89%
		Somewhat disagree	17.74%
		Neither agree nor disagree	14.56%
		Strongly agree	12.97%
		Somewhat agree	12.84%
Changed journey frequency due to travel cost	No longer able to make as many journeys as I did due to travel costs	Strongly disagree	29.06%
		Somewhat disagree	21.98%
		Neither agree nor disagree	19.54%
		Strongly agree	15.63%
		Somewhat agree	13.78%
Gender	Gender	Female	51.29%
		Male	47.95%
		Prefer not to say	0.45%
		Prefer to self-describe	0.17%
		Non-Binary	0.14%
Public transport	Public transport (underground, metro, light rail, tram, train & Bus, minibus or coach) is among the respondent's main modes of travel	Yes	61.70%
		No	38.30%
Active travel	Active travel (bicycle, e-bike & walking) is among the respondent's main modes of travel	Yes	56.04%
		No	43.96%
Age	Age group	Generation Z	5.90%
		Millennials	31.98%
		Generation X	19.63%
		Baby Boomers	31.35%
		Other Age Groups	11.09%
Region location	Region of Scotland you live in	Argyll & Bute	1.72%
		Ayrshire & Arran	7.08%
		Edinburgh and South East Scotland	15.66%
		Forth Valley	5.56%
		Glasgow City	32.90%
		Highlands and Islands	5.73%
		North East Scotland	10.72%
		Scottish Borders	2.18%
		South West Scotland	2.88%
		Tay Cities Region	14.63%
		Prefer not to say	0.93%
Access to car/van	Do you/your household have access to a car or van for private use?	Yes	84.91%
		No	14.99%
		Don't Know	0.10%
Access to bike	Do you/your household have access to a bike suitable for adults?	Yes and roadworthy	46.11%
		Yes but not roadworthy	4.53%
		No	48.89%
		Don't know	0.46%
Social Grade	Social Grade	AB	26.38%
		C1	27.08%
		C2	21.71%
		DE	19.23%
		Refused	5.59%
Health/Disability	Are your day-to-day activities limited because of a health problem or disability which has lasted, or is expected to last, at least 12 months?	Yes, limited a lot	11.98%
		Yes, limited a little	8.87%
		No	76.73%
		Prefer not to say	2.42%
Income	Household income categories before tax and other deductions	Low Income	16.69%
		Medium Income	41.29%
		High Income	42.02%
National Identity	Category which best describes your national identity	Scottish	65.97%
		English	2.42%
		Welsh	0.23%
		Irish	0.79%
		British	25.62%
		Other (please specify)	2.71%
		Prefer Not to say	2.25%

Table A2
Correlation coefficients between dependent and independent variables.

	MODCH	TRIPRED	FEMALE	MILLEN	BOOMER	LOWINC	ABGRAD	MIXED	DISAB	ACTRAV	PUBTRA	BICYAC	CARBUS	CARWALK	CBELT	HIGISL	CPI	WAVE 23
MODCH	1.000																	
TRIPRED	0.382	1.000																
FEMALE	0.005	0.087	1.000															
MILLEN	0.068	0.057	−0.029	1.000														
BOOMER	−0.060	−0.047	0.033	−0.370	1.000													
LOWINC	0.054	0.095	0.018	−0.042	0.062	1.000												
ABGRAD	−0.029	−0.111	0.004	−0.028	0.054	−0.105	1.000											
MIXED	0.082	0.046	0.003	0.089	−0.064	0.008	−0.002	1.000										
DISAB	−0.025	0.095	0.039	−0.082	0.064	0.145	−0.069	−0.021	1.000									
ACTRAV	0.198	0.000	0.022	−0.020	0.018	−0.011	−0.006	0.041	−0.170	1.000								
PUBTRA	0.206	−0.009	0.042	0.013	−0.009	0.050	−0.008	0.074	−0.031	0.294	1.000							
BICYAC	0.038	−0.026	−0.070	0.053	−0.073	−0.112	0.117	0.019	−0.165	0.042	−0.097	1.000						
CARBUS	0.135	0.003	−0.003	0.003	0.007	0.011	−0.001	0.022	−0.007	0.068	0.193	0.016	1.000					
CARWALK	0.151	0.018	0.017	−0.033	0.028	−0.030	0.030	−0.007	−0.059	0.198	0.106	0.049	0.406	1.000				
CBELT	0.071	−0.006	−0.077	0.091	−0.097	−0.040	0.033	0.061	−0.040	0.062	0.153	−0.046	0.041	0.002	1.000			
HIGISL	−0.041	0.029	0.017	−0.080	0.099	0.006	0.015	−0.018	0.040	−0.008	−0.094	0.064	−0.047	−0.038	−0.236	1.000		
CPI	0.053	0.032	0.013	0.037	−0.026	0.009	−0.009	0.027	0.010	−0.033	0.005	−0.001	0.019	0.018	−0.016	0.015	1.000	
WAVE23	−0.059	−0.048	−0.021	−0.037	0.004	−0.032	0.026	−0.029	0.003	0.030	−0.023	0.009	−0.025	−0.039	0.012	−0.009	−0.037	1.000

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