I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 14577

Who Uses Green Mobility? Exploring Profiles in Developed Countries

Lucía Echeverría
J. Ignacio Gimenez-Nadal
José Alberto Molina

JULY 2021

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 14577

Who Uses Green Mobility? Exploring Profiles in Developed Countries

Lucía Echeverría
University of Zaragoza and CONICET

J. Ignacio Gimenez-Nadal
University of Zaragoza and IEDIS

José Alberto Molina
University of Zaragoza, IEDIS and IZA

JULY 2021

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Who Uses Green Mobility? Exploring Profiles in Developed Countries*

Mobility gives individuals access to different daily activities, facilities, and places, but at the cost of imposing environmental burdens. The sustainable growth of society is linked to green mobility (e.g., public transport, walking, cycling) as a way to alleviate individual carbon footprints. This study explores the socio-demographic profile of individuals performing green travel (public and physical modes of transport) and identifies cross-country differences in green travelling behavior. We rely on information from the Multinational Time Use Study, MTUS. for Bulgaria, Canada, Spain, France, Hungary, Italy, the Netherlands, the United Kingdom, and the United States, from 2000 to 2019. We estimate Ordinary Least Squares regressions modelling individual decisions regarding green mobility. Our results indicate that the socio-demographic and family profile of travelers is not homogenous across green modes of transport, with physical travel exhibiting a much more consistent profile, across countries, in comparison to the use of public transport. Results indicate a positive relationship between living in urban areas and the time proportion of green travel, but estimates by country differ in magnitude and depend on the mode. We also find that some countries are more prone to green travel, and that transport infrastructure is more related to the proportion of time travelled by physical transport than by public transport. Our findings help in understanding who is committed to green mobility, while revealing systematic differences across countries that are worth analyzing.

JEL Classification: R40, J22, O57

Keywords: green mobility, public transport, walking/cycling, Multinational Time Use Study

Corresponding author:
José Alberto Molina
University of Zaragoza
Department of Economic Analysis
Gran Vía 2
50005 Zaragoza
Spain
E-mail: jamolina@unizar.es

* This paper has benefitted from funding from the Spanish Ministry of Science and Innovation (Project PID2019-108348RA-I00), and from the Government of Aragón (Grant S32_20R).

1. Introduction

Mobility is an essential part of our daily lives. It provides access to many different activities, such as employment, education, and social, civic and leisure events. Also, mobility allows for changes in location of individuals, and access to different facilities. However, an individual's mobility imposes significant environmental and health burdens. Because it is mainly based on the combustion of fossil fuels, transport is responsible for nearly one quarter of all energy-related greenhouse gas (GHG) emissions (UN, 2019), and forecasts indicate that by 2050, two-thirds of all humanity will be urban, leading to a doubling of motorized mobility and to a 60% increase in CO2 emissions from transport (OECD, 2017). Furthermore, the rapid expansion of motorized transport has increased the incidence of respiratory and cardiovascular disease and has dramatically reduced individual lung function (WHO, 2006).

International organizations have recognized that mobility is central to sustainable development. In this respect, one of the Sustainable Development Goals (SDGs) adopted by all United Nations Member States in 2015 established the need for sustainable transport systems for all by the year 2030. Sustainable mobility, including both public transit and active transport (walking and cycling), may contribute significantly to reduce greenhouse gases emissions, with physical modes being characterized as 'zero carbon' (Stanley and Watkiss, 2003; Chapman, 2007; Gössling and Choi, 2015). However, there is still much to be done to extend the use of green modes of travel, and increasing such modes requires not only improving public transit services, and investing in and promoting walking/cycling behavior, but also understanding who is committed to green mobility.

The existing evidence indicates that the use of green modes of transport can vary substantially across cities and countries (Pucher et al., 2010; Gössling, 2013). Such variations are related to both individual characteristics of travelers and differences in transport infrastructure, services, and policies. On the one hand, studies of different countries have documented that socio-demographic characteristics affect physical mobility (Plaut, 2005; Sener et al., 2009; Adams, 2010) and the use of public transit (Buehler and Pucher, 2012). Factors such as age, gender, education, the number of children in the household, and having access to a car are among the most frequent factors related to green mobility. Furthermore, how green mobility intersects with the urban/rural mix depends on the country under consideration; some studies have found a negative association (Pucher and Renne, 2005), while others show the opposite (Korzhenevych and Jain, 2018).

Prior research is largely based on single countries, with very few exceptions drawing cross-country comparisons of green mobility patterns (Buehler, 2011; Buehler et al., 2011; Buehler and Pucher, 2012; Panik et al., 2019); noteworthy studies of cross-country differences suggest that the relationship between green travelling and individual characteristics is not necessarily generalizable. On the other hand, transportation infrastructure and services, reflecting policy interventions, may play a crucial role in boosting and promoting the use of green modes of travel, but the majority of the analysis comparing countries' infrastructure and strategies are focused on physical modes of transport, especially cycling, for Germany, Denmark, the Netherlands and the UK (Pucher and Dijkstra, 2000; Martens, 2004; Pucher and Buehler, 2008) or for North America (Pucher et al., 1999; Pucher and Buehler, 2006), leaving aside the use of public transit.

Within this framework, we explore the socio-demographic profile of individuals committed to green mobility, and aim to identify cross-country differences in green travel behavior. In doing so, we assess the role of national transportation infrastructure and services in individual choices, via an analysis of several indicators that reflect infrastructure systems. We rely on time use information of 9 developed countries (Bulgaria, Canada, Spain, France, Hungary, Italy, the Netherlands, the United Kingdom, and the United States) from 2000 to 2019, based on the Multinational Time Use Study (MTUS) data sets. We estimate Ordinary Least Squares regressions modelling individual decisions regarding green mobility, captured by the proportion of daily time travelled on public transit of by physical modes of transport.

We find that some countries are more prone to green travelling, net of differences in individuals' socio-demographics characteristics. In addition, we observe that the socio-demographic and family profiles of travelers exhibit much more consistent cross-country relationships in the case of physical modes, in comparison to public transit. We also find a positive relationship between living in urban areas and the time spent in green travel, but estimates by country differ in magnitude, depending on the particular mode. Furthermore, indicators accounting for national transportation infrastructure and services, that reflect transport policies, seem to be more directly related to the proportion of time spent on physical transport than on public transit. Factors such as the extent of rail lines, and density of population seem to be negatively related to the use of physical modes of transport, while the quality of roadway systems, the number of buses, and the proportion of the urban population are related to a greater use of physical modes.

We complement the existing literature by focusing on both public transit and physical modes of transport during all types of travel (work and non-work related), and by considering a broad set of developed countries, including Europe and North America. To our knowledge, no prior research has studied the green travelling behavior of individuals, incorporating urban and rural differences, and the role of the national context, including transport infrastructures, on travel choices, considering public and physical modes. Our results reveal systematic differences in green mobility behavior across countries, and shed light on possible strategies to effectively enhance green travel.

The remainder of the paper is as follows. Section 2 presents a review of the literature. Section 3 presents the data and variables, Section 4 describes the empirical strategy, and Section 5 describes the results. Section 6 sets out our main conclusions.

2. Related Literature

Mobility by car is the preferred mode of travel worldwide. Private cars are currently used for nearly 75% of urban passenger transport in OECD countries, and over 60% in non-OECD countries (OECD, 2019). Despite that some countries have a relatively high proportion of people walking or cycling, the car generally remains the dominant mode of transport in Europe (EEA, 2015). Because the car contributes significantly to environmental pollution and global climate change, green modes of transport (public transit, cycling, and walking) are being promoted as alternative mobility.[1] OECD (2019) projections suggest that the shares

[1] Other modes of transport, such as scooters, moto sharing, car sharing, or car pooling represent alternative modes of transport, and are increasing in importance. For instance, Molina et al. (2020) analyze the role of socio-demographics in the carpooling behavior of individual commuters in Bulgaria, Canada, Spain, Finland, France, Hungary, Italy, South Korea, the United Kingdom, and the United States. The authors find that age, gender, education, being native, and household composition may have similar cross-country relationships to carpooling participation The analysis of this specific modes of transport is beyond the scope of our analysis.

of travel by car will decrease to 46% in OECD countries and to 39% in non-OECD countries, by 2050. In turn, it is expected that travel modes in cities will shift towards public transit.

Evidence in the literature indicates that the share of trips made by bicycle is highly variable across cities of different countries, from 1% in London to 40% in Groningen in The Netherlands (Pucher et al., 2010). Even though there has been considerable growth in bicycle use in recent decades, there are a number of cities where bicycle use is below 1%, including Hong Kong, Warsaw, Sao Paulo, Valencia, Stockholm, Lisbon, Geneva, Rome, and Dubai (Gilbert and Perl, 2008). In comparison, car use range from 16% in Hong Kong to 88% in Chicago (Gössling, 2013). Such variations in the use of green modes of mobility can be related to individual characteristics of travelers, and to cultural factors, as well as to differences in transport infrastructure, services, policies, and weather conditions.[2]

The literature has documented that socio-demographic characteristics of individuals are indeed associated with the use of green modes of transport. In the case of physical modes of travel, evidence from the UK Time Use Survey 2005 (Adams, 2010) indicates that active transport participation (walking, jogging, or cycling for purposes other than enjoyment) is greater in younger individuals and those without access to a car. In addition, regular use of active transport is also related to being unemployed, being in a less affluent social class, and staying longer in full time education. Sener et al. (2009) find, from a survey of Texas cyclists, that individual characteristics of gender, age, education level, the number of automobiles, the number of bicycles, and the number of children, along ith residential location and weather conditions, are all related to bicycle use.

In the case of commuting in the US, Plaut (2005) finds that higher salaries and more expensive housing are associated with a lower propensity to walk or bicycle, while college education shows a greater propensity. The author also finds differences in the likelihood of walking or cycling to work across locational and neighborhood features, race, and gender. However, Heinen et al. (2010), in an overview of the literature, finds a lack of clarity in the connection between socio-economic factors and travelling to work by bicycle, and evidence

[2] For example, Haustein and Nielsen (2006) cluster all EU country members in order to distinguish different mobility cultures and styles within Europe.

of the relationship between cycling, age and income is mixed. Moreover, the authors note that there are large differences across studies from different countries.

Regarding the characteristics of public transit users, Buehler and Pucher (2012) find that in the US and Germany individuals aged between 16 and 24 years, living in high density areas, living in metropolitan areas, and not having a car, are more likely to ride public transport. In the case of the US, being male and employed is positively related to the probability of using public transport. However, the results indicate striking differences in the magnitude of the likelihood of riding public transport between the two countries.

Other studies have compared cross-country differences on the role of socio-demographic characteristics in green travel behavior, finding important differences. Buehler et al. (2011) analyze active travel in Germany and the US and find that the likelihood of walking is related to age, education level, income, the number of cars, and living in urban areas, in both countries, but there are differences in gender and employment status across countries. These authors also find differences in the relationship between cycling and income level, employment status, and the number of cars. The study indicates that there is much less variation in active travel among socioeconomic groups in Germany than in the U.S. In a related study, Buehler (2011) includes public transport in the comparative analysis between Germany and the US, finding that higher household income is related to fewer trips by public transit, and higher population density is associated with more public transport use in both countries. Further, in both countries, trips for households closer to public transport are less likely to be made by car and more likely by public transit. More recently, Panik et al. (2019) study active travel in the US and the Netherlands. Results indicate a similar relationship in the Dutch and American data between time spent on active travel and education, marital status, and level of urbanization, but there are differences in gender, employment, income, and disability.

Cross-country comparisons regarding transport infrastructure and services may reveal how policy interventions can boost the use of green modes of travel, although the majority of the analysis in the literature focuses on physical modes of transport. For instance, a meta-analysis of 139 studies indicates that on-road bicycle lanes, shared bus/bike lanes, signed bicycle routes, bicycle boulevards, maintenance of infrastructure, car-free zones, bicycle parking and stations, among others, all have positive impacts on levels of bicycling (Pucher et al., 2010). Pucher et al. (1999) study Canada and the United States, countries with no tradition of cycling and with primarily car-based infrastructure. The authors highlight that, even though cycling is growing in North America, its mode shares will remain far lower than levels in northern Europe as long as transportation policy remains guided by motoring. Also for Canada and the US, Pucher and Buehler (2006) show that Canadians cycle about three times more than Americans. The authors identify factors explaining the differences across countries, including higher urban densities, higher costs of owning, driving, and parking a car, safer cycling conditions, and more extensive cycling infrastructure and training programs. They indicate that these factors are a result of transport and land-use policies to effectively promote physical mobility, and do not arise from intrinsic cultural or historical differences.

In the case of Europe, Martens (2004) studies the use of bike-and-ride (the combined use of bicycle and public transport for one trip) in three countries with widely differing bicycle infrastructures: The Netherlands, Germany, and the UK. The author finds a small positive relation between bicycle infrastructure and the access distances of bike-and-ride users, with the Netherlands being characterized by longer access distances than Germany and the UK. Differences across countries are especially clear for train services. More people arrive by bicycle at train stations in the Netherlands than in Germany, which in turn has much higher levels of bike-and-train than the UK.

Another important factor needed to increase physical mobility is safety guarantees for active travelers. Pucher and Dijkstra (2000) analyze pedestrian and cyclist safety in the Netherlands and Germany to identify strategies and methods that may be applied to other countries in order to increase the physical mode share. Better facilities for walking and cycling, an urban design sensitive to the needs of active travelers, restrictions on motor vehicles, traffic education, and strict enforcement of traffic laws, are among the measures that these countries have undertaken to improve safety. In line with this, Pucher and Buehler (2008) analyze cycling behavior in Denmark, Germany, and the Netherlands, as these countries have made cycling a safe, convenient, and practical way to get around in cities. They highlight the coordinated nature of a mutually reinforcing set of policies to best explain how these countries promote cycling. These strategies rely on a combination of the provision of separate cycling facilities, traffic control in most residential neighborhoods, cycling rights, ample bike parking, full integration with public transport, promotional events to motivate cycling, and taxes and restrictions on car ownership.

Other studies have addressed differences in green mobility at the aggregate city-level. For example, Taylor at al. (2009) study transit ridership in 265 US urban areas and find that most variations can be explained by regional geography, metropolitan economy, population characteristics, and highway system characteristics. In the case of Europe, Santos et al. (2013) analyze the modal split for travel to work in 112 medium-sized European cities, finding that bicycle share increases with the length of the bicycle network in the city, while public transport share increases with resident population, GDP per capita, and the number of buses in operation, and decreases with public transport fares.

Transport infrastructure and services may also substantially differ in urban and rural areas. For example, bicycle sharing systems are a relatively new and popular form of transport but concentrated in urban areas (O'Brien et al., 2014). In addition, in rural areas, residences and activities are more dispersed, and distances are longer. This may lead to forced reliance on the car, making the use of green modes of transport less viable. In this line, Pucher and Renne (2005) compare travel behavior in rural and urban areas of the U.S, and find that over 97% of rural households own at least one car, as do 92% of urban households. In addition, 91% of trips are made by car in rural areas, compared to 86% in urban areas. Regardless of socio-demographics characteristics, almost everyone in rural areas entirely depends on the car for their travel. However, this is not the case in all countries. A study for the National Capital Region (NCR) of India, one of the world's largest rural-urban regions, compares commuting patterns by non-agricultural workers in urban and rural areas. The evidence reveals a tendency of urban residents to use individual motorized transport more often for both short and long trips. This is particularly true for women, who often choose to commute by car rather than using green modes of transportation. On the contrary, rural areas are characterized by the predominance of non-motorized travel modes (Korzhenevych and Jain, 2018). This mixed evidence suggests that the relationship between green travel and rural location may depend on the country under consideration.

3. Data and Variables

We use the Multinational Time Use Study (MTUS) data set, coordinated by the Centre for Time Use Research (CTUR) at University College, London, and included in the Integrated Public Use Microdata Series (IPUMS) of the Institute for Social Research and Data Innovation of the University of Minnesota (Fisher et al., 2019). The MTUS contains randomly selected time-diary samples from 25 countries over 5 decades. It includes harmonized information on 69 activities performed by individuals during the day, in addition to location, mode of transport, and presence of others during the activity, as well as individual and family-level socio-demographic and geographic characteristics. Information is gathered by completion of personal diaries and household and individual questionnaires.

The use of time-use surveys in transportation research has become common (Gimenez-Nadal and Molina, 2014; 2016; Jara-Díaz and Rosales-Salas, 2015; Gimenez-Nadal, Molina and Velilla, 2018a, 2018b), in the same way that these surveys have become the "gold standard" in the analysis of paid and (specially) unpaid work of individuals (Aguiar and Hurst, 2007; Gimenez-Nadal and Sevilla, 2012). Prior evidence indicates that analysis derived from the use of diary data produce more reliable and accurate estimates, compared to time-use surveys relying on stylized questions and on information on a 'typical day' (e.g., Robinson and Godbey 1985; Juster and Stafford 1985). The caveat is that travel distance cannot be used to analyze travel behavior because information is, a priori, not available in this surveys.

We select countries with time surveys from 2000 to the present, containing comparable information on travelling activities. Our sample is composed of the following countries and years (see Table A.1 of the Appendix): Bulgaria (2001-2002), Canada (2005 and 2010), Spain (2002-2003 and 2009-2010), France (2010), Hungary (2009-2010), Italy (2002-2003 and 2008-2009), the Netherlands (2000 and 2005), the United Kingdom (2000-2001; 2005 and 2014-2015), and the United States (2003 to 2019).

We restrict our analysis to episodes coded as travelling, with non-missing information on the mode of travel. Travel activities include travel to/from work, educational, voluntary, civic, and religious-related travel, child- or adult-care travel, as well as shopping, personal or household care travel, and other travel. Because we are interested in green modes of transport, we construct two variables containing information on travel made by public transport and by physical transport (walking, cycling, and other physically active transport). Specifically, we compute the proportion of time spent on public transit, and the proportion of time spent on a physical mode of transport. To that end, we sum the time travelled (in minutes) by public transport/physical mode by the individual in his/her diary, and divide it by the total time spent in all travelling episodes. These two proportions are the dependent variables in our empirical analysis. The final sample consists of 396,959 individuals.

Table 1 shows the time devoted to daily travel by individuals in our sample, and the proportion of travel that is done by public transport and by physical modes of transport. We observe that the longest average duration of travel is for the Netherlands (93.1 minutes) and Italy (91 minutes), followed by the UK (87 minutes), the US (82.1 minutes) and Canada (81.1 minutes), while the shortest corresponds to Bulgaria (71.1 minutes) and Hungary (70.9 minutes). Considering all countries, individuals devote an average of 84.3 minutes during the day to travelling. Hungary, Spain, and the UK present the largest proportion of time on public transport (11.1%, 10.8% and 9.1%, respectively), while Italy and the US shows the smallest proportions (4.7% and 2.7%). In turn, Bulgaria and Hungary present the largest proportion of time travelled by physical transport (78.7% and 52.8%), followed by Spain and the Netherlands (41.2% and 40.2%), while Canada and the US have the smallest proportion (11.3% and 5.3%). The magnitude of average proportions of green travel reflects outstanding differences across countries, particularly in the case of physical modes of transport. In addition, the US is notably below the average proportions of green travel.

To explore the socio-demographic profile of travelers choosing a green mode of transportation, we consider age, gender, the highest level of formal education achieved (uncompleted secondary or less, completed secondary or above secondary education), and employment status (employed or unemployed), as well as household composition, captured by the presence of a partner (either married or cohabitating), family size and the number of children under 18 years old. Prior evidence indicates that age, gender, education (Plaut, 2005; Sener et al., 2009; Adams, 2010; Buehler and Pucher, 2012; Gimenez-Nadal et al., 2020)[3],

[3] Some of these studies identify automobile ownership as an additional determinant of mode of transport. However, in our MTUS sample this information is not available for all countries. As highlighted in the literature, it is likely that this factor is less important in developed countries, where most households own an automobile, implying that demographic and

and household composition are important determinants of travel behavior (McQuaid and Chen, 2012; Gimenez-Nadal and Molina, 2016).

Table 1 shows summary statistics of the socio-demographic characteristics of individuals in our sample. We observe that the average age of individuals is between 40.66 (the Netherlands) and 49 (Hungary) years old, and around 46% of the sample are men. Hungary and Italy have larger proportions of individuals with less than secondary education (56% and 43%, respectively), while Italy, Bulgaria and France have larger proportions of individuals with secondary education (49%, 48% and 48%), and Canada and the US have larger proportions with education above secondary level (67% and 61%). In addition, 59% of the pool sample are employed, with Italy and Bulgaria being the countries with lower percentages of employed individuals (45% and 48%). Regarding family composition, 57% of the pool sample lives with a partner. In Italy, the US, and Canada about half of the individuals live in couple, while all individuals interviewed in Hungary do. The smallest average family sizes are observed in Canada and France (2.5 members) and the largest in Bulgaria and Spain (3.3 members). Considering the number of children, individuals in the Netherlands, the UK, and the US have, on average, a higher number of children (almost 1 child), while in Canada we observe the opposite (about 0.5 of a child). In general, the distribution of socio-demographics characteristics is relatively similar across countries, with major differences in education levels and family composition.

4. Empirical Strategy

We aim to characterize individuals performing green travel and to identify cross-country differences in the green travel behavior of individuals, conditional on socio-demographic characteristics. To that end, we estimate Ordinary Least Squares (OLS) models at the individual-level, considering two alternative dependent variables: a) the proportion of time travelled by public transport, and b) the proportion of time travelled by a physical mode. We estimate the following specification for the pool sample of countries, including country fixed

household composition variables could be the most relevant determinants of mode of transport in more wealthy countries (Kunert and Lipps, 2005).

effects that allow us to assess which countries are more prone to green travel, net of differences in socio-demographic characteristics of individuals, as follows:

$$P_i = \alpha + \beta X_i + \eta H_i + \delta W_i + \varphi FE_c + \gamma FE_t + \varepsilon_i \quad (1)$$

where P_i is either the proportion of travel time by public transit or the proportion of travel time by physical mode. X_i is a vector of socio-demographic variables, including age (and its square), gender, education level, and employment status. H_i is a vector of household composition variables, including the presence of a partner (either married or cohabitating), household size, and number of children. W_i controls whether the person's diary corresponds to a weekday or weekend. FE_c are country fixed effects, where the US is the reference country. FE_t are year fixed effects and ε_i are unmeasured factors. Standard errors are robust, and the error term is clustered at the country level. Observations are weighted at the individual-level using the survey weights.

To further investigate differences across countries, we explore the role that transport infrastructure may have on the green travel behavior of individuals. To this end, we estimate Eq. (1), omitting country fixed effects but including instead a set of 10 relevant indicators defined at the country-year level, matching the composition of our MTUS sample (see Table A.1 of the Appendix). These indicators control for factors related to transport infrastructure and services, road security, and country characteristics, such as economic growth and urban distribution, that are likely to be correlated with green travel choices.

We include the length of railway route available for train service in km (divided by 1,000), the length of motorways in km (divided by 1,000), the number of buses available for services (divided by 1,000), the number of private vehicles, including cars and motorcycles (divided by 10,000), the number of passengers transported by railways, times km traveled (divided by 1,000), mortality caused by road traffic injury (per 100,000 population), carbon dioxide emissions from liquid fuel consumption in kt (divided by 10,000), the proportion of individuals living in urban areas, GDP per capita growth (annual %) and population size. The length of rail lines, passengers, mortality, CO2 emissions, proportion of urban population, GDP per capita growth and population indicators are taken from the World Development Indicators of the World Bank Database, while the length of motorways, the number of buses, and the number of private vehicles are taken from Eurostat, in the case of European countries, from the Bureau of Transportation Statistics of the United States, and from Statistics Canada.

Average values of country indicators are presented in Table 2. United States and Canada are the countries with the most extensive rail line routes and motorways, followed by France, the UK, and Italy in the case of rail lines, and by Spain and France in the case of motorways. The US also has the largest number of buses, while the UK stands out among European countries. However, when accounting for the size of the population, the infrastructure of buses is relatively similar across countries, but is considerably higher in Bulgaria. In addition, Italy and France have the highest number of vehicles per inhabitant, while Hungary and Bulgaria have the lowest. Mortality rates are the highest in Bulgaria and the US, followed by Italy. Regarding CO2 emissions from liquid fuel consumption, the US records the largest figures. In the years under consideration for each country, Bulgaria presents the highest GDP per capita growth and Hungary the lowest.

To explore cross-country heterogeneities in the socio-demographic characteristics of individuals engaging in green travel, we estimate a similar specification to Eq. (1) but for each country c:

$$P_{ic} = \alpha_c + \beta_c X_{ic} + \eta_c H_{ic} + \delta_c W_{ic} + \gamma_c FE_{tc} + \varepsilon_{ic} \quad (2)$$

In this case, the error term is clustered at the individual level.

We are also interested in assessing whether living in urban areas is related to larger time proportions of public and physical travels. However, some of the countries in our sample do not report this information (Bulgaria, France, and the UK in the 2005 and 2014-2015 surveys).[4] Considering the remaining countries, the percentage of individuals living in urban areas in our sample is 91% in the UK, 83% in the US, 81% in the Netherlands, 76% in Canada, 70% in Spain, 68% in Hungary, and 60% in Italy.

For this reason, we incorporate in Eq. (2) an indicator variable that takes value 1 if the respondent lives in an urban area, and 0 otherwise, in a separate set of regressions by country, considering only those countries that collect this information.

[4] We eliminate 1,571 observations with missing urban information from the US sample.

It is important to note that our sample includes a considerable number of individuals not travelling by either public or physical modes of transport (see Table 1). This may indicate that a Tobit model could be implemented to account for the censoring. However, prior studies have found similar results when comparing OLS models to Tobit models in the study of time-allocation decisions (Frazis and Stewart, 2012; Gershuny, 2012; Foster and Kalenkoski, 2013; Gimenez-Nadal and Molina, 2014, 2016). As a consequence, and for the sake of simplicity, we rely on OLS regressions, but we have estimated Tobit regressions for the three specifications of interest, and find that our results are robust in size and sign to the estimation method. Estimates of the Tobit regressions are available upon request.

5. Results

We explore the characteristics of individuals performing green travel and identify cross-country differences in green travel behavior, using the pooled sample of countries. We present Ordinary Least Squares regressions modelling individual decisions regarding green mobility, captured by the proportion of time travelled by public transport and the proportion of time travelled by a physical mode. Regressions are performed at the individual-level. In all Tables, estimated coefficients are multiplied by 100 in order to directly express the change in percentage points of the time proportion of green travel associated with a change in the covariates of interest.[5]

Table 3 reports the estimates of Eq. (1) for the pooled sample of countries. We find that all socio-demographic and household composition variables are significantly associated with the proportion of time travelled by public transport. However, we find that socio-demographic and family profiles of travelers are not homogenous across green modes of transport. Only in the case of gender and living in a couple do the estimated correlations have a negative sign, in both kinds of green travel. We observe a U-shaped correlation between age and the proportion by public transport, while the use of a physical mode of transport has

[5] Note that the R-squared statistics in the pool estimation of the proportion of time travelled by public transit, and in all estimations by country are low. This suggests that green travel behavior is probably conditioned by non-observable characteristics.

a positive relationship with age.[6] Being male, living with a partner, and family size are negatively related to the proportion of public transit travel, while having a secondary or higher level of education, being employed, and having more children are positively related. The largest average percentage point changes in the proportion of public transport are positive and associated with education level (a 2-point increase if the individual has secondary education and a 3-point increase in the case of higher education), employment status (4.9 points if employed) and travel on a weekday (3 points if individuals travel at weekends).

Being male, having more formal education, being employed, living with a partner, and having more children is negatively associated with the proportion of physical travel mode. A positive correlation is found for household size and travel during the week, while no relationship is found for the age of individuals. The largest average percentage point changes in the proportion by public transit are negative and driven by being male (a 7-point decrease), education level (a 5.3-point decrease if the individual has secondary education and an 8.7-point decrease for higher education) and employment status (a 9.2-point decrease if employed).

Table 3 reveals statistically significant cross-country differences in the green travel behavior of individuals. Considering the US as the reference country, and net of cross-individual differences in socio-demographic and family characteristics, we observe that individuals in all the other countries are more likely to travel a larger fraction of their time by a green mode of transport, compared to individuals in the US. In particular, in Hungary, Spain, Bulgaria, and France, the proportion of time travelled by public transit is 12 points, 9.8 points, 6.9 points, and 6.6 points larger, respectively, than in the US. However, even major differences are found when analyzing the proportion of travel by physical transport, where differences with respect to the US reach 69 points in Bulgaria, 41 points in Hungary, 33 points in the Netherlands, and 31 points in Spain.

To further examine cross-country differences in green travel behavior, we now include indicators at the country level. Table 4 reports estimates of Eq. (1) without country fixed

[6] The age at when the use of public transport is minimum is reached at the age of 99, and thus it could be well considered there is a negative correlation between age and the use of public transport.

effects but including national-level indicators related to transport infrastructure and country characteristics. We find that the number of buses, mortality caused by road traffic injury, and the proportion of people living in urban areas is significantly and positive related to the fraction of time travelled by public transit. However, the remaining national indicators seem not to be associated with the proportion by public transit. Regarding physical travel, we observe that better infrastructure in terms of length of motorways, number of buses and private vehicles, and passengers carried by railways is positively correlated with the fraction of travel time by physical means. In addition, the proportion of urban population, the rate of mortality in traffic injuries, and the per-capita GDP growth rate also positively relate to the proportion of time travelled by a physical mode. On the other hand, the length of rail lines and the country population are significantly and negatively associated with the proportion by physical mode. Finally, we find a negative and significant relationship between CO2 emissions and the proportion by physical mode. Note also that the inclusion of national indicators does not change our results regarding the conditional correlations between observable individual or family characteristics and green travelling choices.

We now explore cross-country differences in the relationship between green travelling, on the one hand, and socio-demographic and household characteristics, on the other. To that end, in Tables 5 and 6 we show estimates of Eq. (2) for our two dependent variables, by country.

Regarding the proportion of time travelled by public transport, we find interesting cross-country heterogeneities (Table 5). We observe a negative relationship with age that holds for Bulgaria and the UK, while for the other countries we find a u-shaped relationship with the proportion of travel by public transport. Being male is negatively associated with the proportion of public transit in Spain, Hungary, the Netherlands, Italy, and Canada, but positively associated in the US, while no relationship is found for Bulgaria, France, and the UK. Individuals with different levels of education also exhibit differences in their time proportion of green travel via public transit, depending on the country. More educated travelers spend more time on public transit in Bulgaria, Spain, Italy, and the Netherlands, but less time in Canada and the US, while no associations are found in Hungary. In France and the UK, results are mixed; in the UK the relationship is not significant for individuals with education above secondary, and in France the association is negative for travelers with secondary education but positive for those with higher education.

Working travelers spend more time on public transit in Bulgaria and Hungary, but a less time in Canada, Italy, the Netherlands, the UK, and the US. No association is observed for travelers in Spain and France. Regarding family composition, the presence of a partner is negatively associated with the fraction of travel time by public transit in all countries. In addition, correlations with household size are positive for Spain, Hungary, Italy, the Netherlands, and the UK, but negative for Bulgaria. No association is observed for travelers in Canada, France, Hungary, and the US. The number of children is negatively related to the time on public transit in all countries, with the exception of Bulgaria, France, and Italy, where no relationship is observed.

Regarding the proportion of time travelled by physical transport (Table 6), we observe that, even though the age of travelers is not significant for the pool sample, there is a u-shaped relationship in Canada, Spain, France, Italy, the Netherlands, and the UK, and an inverted u-shaped association in the US. Being male is negatively associated with the proportion of physical transport in all countries, with the exceptions of Canada (no relationship) and the US (positive relationship). More educated and employed travelers spend a lower fraction of travelled time in physical transportation in all countries. Regarding family composition, the presence of a partner is negatively associated with the fraction of time travelled by physical transport in all countries, with the exception of Bulgaria, where no relationship is found. In addition, correlations with household size are negative and correlations with the number of children are positive in all countries, with the exceptions of Bulgaria, Hungary, and the UK. Finally, individuals spend a larger proportion of their travels in green modes of transport during the week in all countries, except for individuals in Hungary travelling via physical transport.

In sum, the socio-demographic and family profile of green travelers is robust across countries in the case of physical modes, in comparison to public transit. In addition, our results present some interesting regularities regarding green travelling behavior when comparing different countries.

Exploring urban and rural differences

We now explore the role of living in urban or rural areas in the green behavior of individuals. We estimate Eq. (2) including a variable that indicates if the respondent lives in an urban area (for those countries that collect this information; Bulgaria and France are excluded from the analysis). Results are shown in Table 6 for the case of public transit and Table 7 for physical modes. Note that including the urban information in the estimation does not alter our results regarding socio-demographic and household composition. Furthermore, the relationship between living in urban areas and the proportion of green travel is, in general, consistent across countries. However, estimates by country differ in magnitude when analyzing public or physical modes.

We observe that living in urban areas is significantly and positively associated with the proportion of time travelled by public transport in all countries, with the exception of Hungary. The strongest links are found for Spain and Canada, where individuals living in urban areas spend a larger proportion of their travel in public transit compared to those living in rural areas (5.8 points and 5.6 points more, respectively), followed by the UK (3.7 points), the US (2.2 points), the Netherlands (1.5 points) and Italy (1.1 points).

Living in urban areas is also significantly and positively associated with the proportion of time travelled by physical mode in all countries, with the exception of Hungary (no relationship) and Italy (negative relationship). Differing from the estimated changes in the proportion by public transport, in this case the strongest links are found for the UK and the Netherlands (8.3 points, and 6.9 points), followed by Spain (4.6 points), the US (2 points) and Canada (1.1 points). In contrast, individuals living in urban areas in Italy spend a lower proportion of time travelling by physical transport (1 point).

6. Conclusions

This paper analyses the green behavior of individuals in 9 developed countries, analyzing the proportion of travel that is done by public transit and/or physical mode, in Bulgaria, Canada, Spain, France, Hungary, Italy, the Netherlands, the United Kingdom, and the United States, from 2000 to 2019. Our results indicate that the socio-demographic and family profile of travelers is not homogenous across green modes of transport, with physical travel exhibiting a much more consistent cross-country profile in comparison to the use of public transit. Factors such as age, education, employment status, marital status, and the presence of children are related to the proportion of travel by public transit or physical mode.

Our results shed light on which groups in the population are more or less likely to use green modes, and may guide specific actions and public policies, with the aim of increasing the use of green modes of transport. Thus, our results may be of interest for policymakers in the design of efficient policies aimed at decreasing energy consumption and GHG emissions through the increased use of green modes. For instance, our results show a positive relationship between living in urban areas and the proportion of green travel, which calls for public policies aimed at increasing the availability of infrastructures (bike lanes) or transport services (bus lines and bus availability), consistent with results showing the importance of these country factors in shaping individual travel behavior. Furthermore, if being male, being married, the absence of children, or having a low level of education are all related to lower use of public transit, perhaps public policies subsidizing the use of public transport for these specific groups in the population would benefit the environment, although here we do find cross-country differences in these relationships. The use of public transit and physical modes is more frequent during weekends, in comparison to working days, which contrasts with the design of road-pricing policies at certain hours of working days as a way to alleviate pollution (Coria and Zhang, 2017) and increase the use of public transit (Kilani, Proost and van der Loo, 2014). On the other hand, our results show that the appropriate planning and design of infrastructures and services (e.g., length of motorways; number of buses) may boost the use of green modes, while population density is also related to a greater use of public transit and physical modes. However, cross-country differences are not fully explained by our results, and factors such as cross-individual heterogeneity, which may include "green culture" or "attitudes towards the environment", also affect the use of green modes of transport.

One limitation of the current research is that road freight is not included in the analysis of commuting. It would be interesting to focus on the travel patterns of those who work in the logistics sector, who spend time driving while working. A second limitation of our analysis is that we cannot control for the unobserved heterogeneity of individuals, which is important in this context, since unobserved factors (e.g., preferences, previous experience, parents' background) may condition decisions about what kind of transport individuals use, and how much time is spent in travel. One way to overcome this limitation is to use data with a panel structure. Finally, we have not found a consistent cross-country dataset with information about structures and services for physical transport (e.g., bike lanes, walking paths, bike stations), which would be helpful in analyzing how the availability of these factors is related to the use of physical modes. We leave this issue for future research.

REFERENCES

Adams, J. 2010. Prevalence and socio-demographic correlates of "active transport" in the UK: analysis of the UK time use survey 2005. *Preventive Medicine*, *50*(4), 199-203.

Bresson, G., Dargay, J., Madre, J. L., and Pirotte, A. 2003. The main determinants of the demand for public transport: a comparative analysis of England and France using shrinkage estimators. *Transportation Research Part A: Policy and Practice*, 37(7), 605-627.

Buehler, R. 2011. Determinants of transport mode choice: a comparison of Germany and the USA. *Journal of Transport Geography*, *19*(4), 644-657.

Buehler, R., and Pucher, J. 2012. Demand for public transport in Germany and the USA: an analysis of rider characteristics. *Transport Reviews*, *32*(5), 541-567.

Buehler, R., Pucher, J., Merom, D., and Bauman, A. 2011. Active travel in Germany and the US: contributions of daily walking and cycling to physical activity. *American Journal of Preventive Medicine*, *41*(3), 241-250.

Chapman, L. 2007. Transport and climate change: a review. *Journal of Transport Geography*, *15*(5), 354-367.

Coria, J., and Zhang, X. B. (2017). "Optimal environmental road pricing and daily commuting patterns," *Transportation Research Part B: Methodological*, 105, 297-314.

EEA. 2015. *The European Environment — State and Outlook 2015: Synthesis Report*. European Environment Agency, Copenhagen.

Fisher, K., Gershuny, J., Flood, S. M., Backman, D., and Hofferth, S. L. 2019. Multinational Time Use Study Extract System: Version 1.3 [dataset]. Minneapolis, MN: IPUMS.

Foster, G., and Kalenkoski, C. 2013. Tobit or OLS? An Empirical Evaluation under Different Diary Window Lengths. *Applied Economics*, 45, 2994–3010.

Frazis, H., and Stewart, J. 2012. How to Think About Time-Use Data: What Inferences Can We Make About Longand Short-Run Time Use from Time Use Diaries?. *Annals of Economics and Statistics*, 105/106, 231–46.

Gershuny, J. 2009. Veblen in reverse: Evidence from the multinational time-use archive. *Social Indicators Research*, *93*(1), 37-45.

Gershuny, J. 2012. Too Many Zeros: A Method for Estimating Long-term Time-use from Short Diaries. *Annals of Economics and Statistics*, 105/106, 247–70.

Gilbert, R., and Perl, A. 2008. *Transport Revolutions. Moving People and Freight without Oil*. Earthscan, London.

Gimenez-Nadal, J. I., Molina, J. A., and Velilla, J. 2018a. The commuting behavior of workers in the United States: Differences between the employed and the self-employed. *Journal of Transport Geography*, 66(1), 19-29.

Gimenez- Nadal, J. I., Molina, J. A., and Velilla, J. 2018b. Spatial distribution of US employment in an urban efficiency wage setting. *Journal of Regional Science*, 58(1), 141-158.

Gimenez-Nadal, J. I., and Molina, J. A. 2014. Commuting time and labour supply in the Netherlands: A time use study. *Journal of Transport Economics and Policy*, 48(3), 409-426.

Gimenez-Nadal, J. I., and Molina, J. A. 2016. Commuting time and household responsibilities: Evidence using propensity score matching. *Journal of Regional Science*, 56(2), 332–359.

Gimenez-Nadal, J. I., and Molina, J. A. 2019. Green commuting and gasoline taxes in the United States. *Energy Policy*, *132*, 324-331.

Gössling, S. 2013. Urban transport transitions: Copenhagen, city of cyclists**.** *Journal of Transport Geography*, 33, 196-206.

Gössling, S., and Choi, A. S. 2015. Transport transitions in Copenhagen: Comparing the cost of cars and bicycles. *Ecological Economics*, *113*, 106-113.

Haustein, S., and Nielsen, T. A. S. 2016. European mobility cultures: A survey-based cluster analysis across 28 European countries. *Journal of Transport Geography*, 54, 173-180.

Jara-Díaz, S., and Rosales-Salas, J. 2015. Understanding time use: Daily or weekly data? T*ransportation Research Part A: Police and Practice*, 76(1), 38-57.

Juster, T., and Stafford, F. 1985. *Time, Goods, and Well-Being*. Ann Arbor: Institute for Social Research, The University of Michigan.

Kilani, M., Proost, S., and van der Loo, S. (2014). "Road pricing and public transport pricing reform in Paris: Complements or substitutes?," Economics of Transportation, 3(2), 175-187,

Korzhenevych, A., and Jain, M. 2018. Area-and gender-based commuting differentials in India's largest urban-rural region. *Transportation Research Part D: Transport and Environment*, *63*, 733-746.

Kunert, U., and Lipps, O. 2005. Measuring and Explaining the Increase of Travel Distance: A Multi-Level Analysis Using Repeated Cross Sectional Travel Surveys. DIW, Berlin.

Martens, K. 2004. The bicycle as a feedering mode: experiences from three European countries. *Transportation Research Part D: Transport and Environment*, 9(4), 281-294.

McQuaid, R. W., and Chen, T. 2012. Commuting times: The role of gender, children and part-time work. *Research in Transportation Economics*, 34(1), 66-73.

Molina, J. A., Giménez-Nadal, J. I., and Velilla, J. 2020. Sustainable commuting: Results from a social approach and international evidence on carpooling. *Sustainability*, *12*(22), 9587.

O'Brien, O., Cheshire, J., and Batty, M. 2014. Mining bicycle sharing data for generating insights into sustainable transport systems. *Journal of Transport Geography*, 34, 262-273.

OECD. 2017. *ITF Transport Outlook 2017*. OECD Publishing.

OECD. 2019. *IFT Transport Outlook 2019*. OECE Publishing.

Panik, R. T., Morris, E. A., and Voulgaris, C. T. 2019. Does walking and bicycling more mean exercising less? Evidence from the US and the Netherlands. *Journal of Transport & Health*, *15*, 100590.

Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., Shires, J., and White, P. 2006. The demand for public transport: The effects of fares, quality of service, income and car ownership. *Transport Policy*, 13(4), 295-306.

Plaut, P. O. 2005 Non-motorized commuting in the US. *Transportation Research Part D: Transport and Environment*, *10*(5), 347-356.

Pucher, J., and Buehler, R. 2006. Why Canadians cycle more than Americans: a comparative analysis of bicycling trends and policies. *Transport Policy*, 13(3), 265-279.

Pucher, J., and Buehler, R. 2008. Making cycling irresistible: lessons from the Netherlands, Denmark and Germany. *Transport Reviews*, 28(4), 495-528.

Pucher, J., and Dijkstra, L. 2000. Making walking and cycling safer: lessons from Europe. *Transportation Quarterly* 54, 25–50.

Pucher, J., and Renne, J. L. 2005. Rural mobility and mode choice: Evidence from the 2001 National Household Travel Survey. *Transportation*, *32*(2), 165-186.

Pucher, J., Dill, J., and Handy, S. 2010. Infrastructure, programs, and policies to increase bicycling: an international review. *Preventive Medicine*, 50, S106-S125.

Pucher, J., Komanoff, C., and Shimek, P. 1999. Bicycling renaissance in North America? Recent trends and alternative policies to promote bicycling. *Transportation Research A: Policy and Practice,* 33, 625–654.

Robinson, J.P., and Godbey, G. 1985. *Time for Life: The Surprising Ways Americans Use Their Time*. Penn State University Press, University Park, Pennsylvania.

Santos, G., Maoh, H., Potoglou, D., and von Brunn, T. 2013. Factors influencing modal split of commuting journeys in medium-size European cities. *Journal of Transport Geography*, *30*, 127-137.

Sener, I. N., Eluru, N., and Bhat, C. R. 2009. Who are bicyclists? Why and how much are they bicycling?. *Transportation Research Record*, *2134*(1), 63-72.

Stanley, J., and Watkiss, P. 2003. Transport energy and emissions: buses. In *Handbook of Transport and the Environment*. Emerald Group Publishing Limited; Hensher, D.A., Button, K.J., Eds.; Elsevier: Amsterdam, The Netherlands, 2003; pp. 227–246.

Taylor, B. D., Miller, D., Iseki, H., and Fink, C. 2009. Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas. *Transportation Research Part A: Policy and Practice*, *43*(1), 60-77.

United Nations. 2019. *Emissions Gap Report 2019*. United Nations Environment Programme, Nairobi

World Health Organization. 2006. *Air quality guidelines: global update 2005: particulate matter, ozone, nitrogen dioxide, and sulfur dioxide*. World Health Organization.

Tables

Table 1. Descriptive Statistics by Country

	all countries		Bulgaria		Canada		Spain		France	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
travelling information										
travelling duration (minutes)	84.3	72.6	71.1	54.4	81.1	76.0	75.2	59.3	93.4	78.7
proportion of time travelled by public	5.1	19.3	7.1	21.2	6.4	22.2	10.8	28.0	5.8	21.1
proportion of time travelled by physical	20.7	36.5	78.7	36.2	11.3	28.2	41.2	44.1	22.0	37.4
% of individuals not using public	92.3%		87.8%		91.4%		84.9%		91.9%	
% of individuals not using physical	67.0%		12.3%		78.4%		42.8%		68.2%	
socio-demographic characteristics										
age	44.61	18.01	44.17	17.65	46.48	17.24	42.92	18.17	48.98	16.75
male	0.46	0.50	0.51	0.50	0.45	0.50	0.49	0.50	0.47	0.50
uncompleted secondary or less	0.25	0.43	0.35	0.48	0.17	0.38	0.30	0.46	0.29	0.45
completed secondary	0.33	0.47	0.48	0.50	0.15	0.36	0.36	0.48	0.48	0.50
above secondary	0.42	0.49	0.17	0.38	0.67	0.47	0.34	0.47	0.23	0.42
employee	0.59	0.49	0.48	0.50	0.63	0.48	0.51	0.50	0.51	0.50
presence of a partner	0.57	0.50	0.66	0.47	0.56	0.50	0.60	0.49	0.63	0.48
household size	2.93	1.44	3.37	1.59	2.51	1.29	3.35	1.33	2.54	1.31
number of children	0.78	1.06	0.71	0.93	0.49	0.83	0.69	0.93	0.61	1.00
Number of individuals	396,959		10,450		28,384		34,652		20,366	

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix.

Table 1 (Cont.). Descriptive Statistics by Country

	Hungary		Italy		Netherlands		UK		US	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
travelling information										
travelling duration (minutes)	70.9	58.0	91.0	72.5	93.1	72.4	87.0	72.9	82.1	74.3
proportion of time travelled by public	11.1	26.9	4.7	17.7	7.3	22.2	9.1	24.9	2.7	14.1
proportion of time travelled by physical	52.8	45.5	34.4	41.0	40.2	43.8	20.0	35.1	5.3	19.2
% of individuals not using public	83.4%		92.1%		88.5%		86.0%		96.0%	
% of individuals not using physical	33.9%		43.9%		45.9%		67.7%		86.7%	
socio-demographic characteristics										
age	49.00	13.43	42.65	20.15	40.66	17.34	42.26	18.51	45.84	17.03
male	0.50	0.50	0.50	0.50	0.44	0.50	0.46	0.50	0.45	0.50
uncompleted secondary or less	0.56	0.50	0.43	0.49	0.27	0.45	0.30	0.46	0.14	0.35
completed secondary	0.23	0.42	0.49	0.50	0.39	0.49	0.34	0.47	0.25	0.43
above secondary	0.21	0.41	0.08	0.27	0.33	0.47	0.36	0.48	0.61	0.49
employee	0.57	0.49	0.45	0.50	0.56	0.50	0.61	0.49	0.68	0.47
presence of a partner	1.00	0.00	0.53	0.50	0.61	0.49	0.61	0.49	0.54	0.50
household size	3.18	1.21	3.18	1.28	2.88	1.41	2.96	1.41	2.81	1.52
number of children	0.64	0.97	0.68	0.94	0.83	1.11	0.84	1.13	0.90	1.15
number of individuals	3,467		76,640		22,538		28,581		171,881	

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix.

Table 2. Average National Indicators by Country

	Bulgaria	Canada	Spain	France	Hungary	Italy	Netherlands	UK	US
length of rail lines [a]	4,320	47,041	14,719	29,929	7,897	16,615	2,808	16,658	174,098
length of motorways [b]	328	38,010	12,080	11,392	1,375	6,566	2,433	3,666	350,468
number of buses [b]	37,000	62,257	60,027	91,451	17,681	95,139	11,182	172,728	850,506
number of vehicles [b]	2,965,300	18,941,271	27,691,419	41,027,848	3,624,475	44,648,337	8,321,370	35,318,830	131,693,645
passengers by railways [a]	3,231	1,441	21,983	10,2167	7,883	47,207	15,065	59,278	31,533
mortality [a]	13.1	8.4	9.6	6.5	9.8	10.5	6.3	5.3	13.2
CO2 emissions [a]	10,550	251,707	164,749	201,538	15,946	221,500	68,996	181,132	2,206,394
% of urban population [a]	69.0	80.5	77.5	78.4	68.7	67.8	79.7	80.5	81.0
GDP per capita growth [a]	5.6	1.9	-0.6	1.4	-2.6	-1.9	2.6	2.3	1.3
population [a]	8,089,657	33,124,321	44,139,762	65,027,507	10,011,337	58,073,577	16,122,691	61,626,382	310,670,573

Note: Indicators are defined by country and year in order to match our MTUS sample.

[a] indicators taken from the World Development Indicators of the World Bank Database, [b] taken from Eurostat in the case of European countries, and from the Bureau of Transportation Statistics of the United States and from Statistics Canada.

Table 3. Socio-demographic determinants of the proportions of public and physical transport, all countries

	Prop. by public transport	**Prop. by physical transport**
age	-0.199***	-0.003
	(0.029)	(0.028)
age squared	0.001***	0.001***
	(0.000)	(0.000)
male	-0.357***	-6.966***
	(0.075)	(0.423)
completed secondary	2.033***	-5.257***
	(0.050)	(0.221)
above secondary	3.060***	-8.729***
	(0.230)	(0.262)
employee	4.992***	-9.204***
	(0.423)	(0.184)
presence of a partner	-1.627***	-1.438***
	(0.073)	(0.173)
household size	-0.671***	0.418***
	(0.056)	(0.083)
number of children	0.669***	-0.446**
	(0.107)	(0.142)
weekday	3.089***	4.720***
	(0.054)	(0.244)
Bulgaria	7.142***	69.132***
	(1.146)	(1.087)
Canada	4.436***	4.923***
	(0.597)	(0.885)
Spain	10.064***	31.482***
	(0.320)	(0.339)
France	6.739***	10.342***
	(1.110)	(1.494)
Hungary	12.504***	41.222***
	(1.015)	(1.404)
Italy	5.236***	24.812***
	(0.835)	(0.919)
Netherlands	5.051***	33.199***
	(0.558)	(0.527)
United Kingdom	5.981***	14.070***
	(0.328)	(0.662)
constant	3.666**	14.219***
	(1.129)	(1.841)
Year FE	Yes	Yes
R-squared	0.034	0.220
Number of individuals	396,959	396,959

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix. Dependent variables are the proportion of time travelled by public transport and the proportion of time travelled by physical transport. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Country fixed effects with United States as the reference country. Robust standard errors clustered at the country level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 4. Socio-demographic determinants of the proportions of public and physical transport, all countries with national indicators

	Prop. by public transport	Prop. by physical mode
age	-0.198***	-0.001
	(0.029)	(0.027)
age squared	0.001***	0.001***
	(0.000)	(0.000)
male	-0.357***	-6.970***
	(0.075)	(0.420)
completed secondary	2.026***	-5.243***
	(0.056)	(0.208)
above secondary	3.055***	-8.732***
	(0.235)	(0.257)
employee	4.985***	-9.227***
	(0.430)	(0.184)
presence of a partner	-1.619***	-1.426***
	(0.064)	(0.162)
household size	-0.672***	0.429***
	(0.055)	(0.071)
number of children	0.669***	-0.455***
	(0.107)	(0.133)
weekday	3.089***	4.725***
	(0.053)	(0.239)
length of rail lines (km)	-0.150	-2.654***
	(0.008)	(0.368)
length of motorways (km)	0.006	2.743***
	(0.124)	(0.648)
number of buses	0.046**	0.441***
	(0.020)	(0.088)
number of private vehicles	0.001	0.054***
	(0.003)	(0.015)
passengers by railways	0.006	0.471**
	(0.029)	(0.158)
mortality	1.429***	4.110***
	(0.329)	(1.063)
CO2 emissions	-0.006	-1.074*
	(0.109)	(0.562)
% of urban population	0.545**	1.743**
	(0.189)	(0.609)
GDP per capita growth	-0.178	3.961**
	(0.352)	(1.626)
population	-0.002	-0.047***
	(0.002)	(0.011)
constant	-42.562**	-103.021*
	(16.603)	(52.141)
Year FE	Yes	Yes
R-squared	0.034	0.219
Number of individuals	396,959	396,959

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix. Dependent variables are the proportion of time travelled by public transport and the proportion of time travelled by physical mode. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Robust standard errors clustered at the country level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 5. Socio-demographic determinants of the proportion of time travelled by public transport, by country

	Bulgaria	**Canada**	**Spain**	**France**	**Hungary**	**Italy**	**NL**	**UK**	**US**
age	-0.171*	-0.477***	-0.441***	-0.590***	-0.662**	-0.339***	-0.424***	-0.125**	-0.107***
	(0.095)	(0.053)	(0.054)	(0.085)	(0.259)	(0.029)	(0.098)	(0.061)	(0.018)
age squared	0.001	0.003***	0.004***	0.005***	0.007***	0.003***	0.003***	0.001	0.000***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)	(0.001)	(0.000)
male	-0.289	-0.575**	-3.984***	-0.332	-2.986***	-1.010***	-1.132**	-0.460	0.472***
	(0.569)	(0.292)	(0.329)	(0.371)	(0.994)	(0.195)	(0.548)	(0.357)	(0.088)
completed second.	2.056***	-2.923***	2.120***	-1.598***	1.140	1.292***	5.086***	-1.317***	-3.571***
	(0.666)	(0.489)	(0.432)	(0.440)	(1.192)	(0.229)	(0.694)	(0.477)	(0.180)
above secondary	3.223***	-1.077**	2.014***	3.361***	1.446	2.134***	6.610***	-0.173	-3.088***
	(0.971)	(0.427)	(0.437)	(0.602)	(1.357)	(0.370)	(0.741)	(0.490)	(0.171)
employee	5.373***	-1.437***	-0.275	0.072	7.227***	-2.187***	-1.228*	-2.697***	-0.647***
	(0.644)	(0.378)	(0.386)	(0.438)	(1.092)	(0.230)	(0.673)	(0.493)	(0.110)
presence of partner	-1.571**	-3.982***	-4.232***	-5.426***	-	-2.890***	-7.013***	-6.772***	-2.398***
	(0.723)	(0.334)	(0.427)	(0.598)	-	(0.236)	(0.809)	(0.481)	(0.107)
household size	-0.722***	0.199	0.641***	-0.203	0.293	0.174*	1.482***	0.883***	0.031
	(0.243)	(0.197)	(0.162)	(0.347)	(0.551)	(0.098)	(0.472)	(0.250)	(0.071)
number of children	0.770	-0.929***	-1.679***	-0.364	-1.369*	-0.010	-2.851***	-1.671***	-0.249***
	(0.483)	(0.227)	(0.223)	(0.372)	(0.707)	(0.137)	(0.503)	(0.288)	(0.082)
weekday	3.111***	4.492***	5.494***	2.567***	2.067*	3.415***	2.895***	2.471***	1.785***
	(0.409)	(0.266)	(0.297)	(0.254)	(1.055)	(0.143)	(0.360)	(0.271)	(0.070)
constant	12.654***	21.585***	21.986***	25.324***	19.412***	13.586***	15.168***	15.101***	9.907***
	(2.359)	(1.360)	(1.249)	(2.328)	(6.201)	(0.636)	(2.179)	(1.281)	(0.478)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.035	0.047	0.046	0.053	0.019	0.048	0.064	0.032	0.026
N. individuals	10,450	28,384	34,652	20,366	3,467	76,640	22,538	28,581	171,881

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix. Dependent variable is the proportion of time travelled by public transport. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Robust standard errors clustered at the individual level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 6. Socio-demographic determinants of the proportion of time travelled by physical mode, by country

	Bulgaria	Canada	Spain	France	Hungary	Italy	NL	UK	US
age	0.011	-0.296***	-0.115	-0.820***	-0.339	-0.286***	-0.914***	-0.159*	0.149***
	(0.138)	(0.071)	(0.081)	(0.129)	(0.403)	(0.057)	(0.190)	(0.090)	(0.023)
age squared	0.001	0.002***	0.005***	0.010***	0.004	0.009***	0.009***	-0.000	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.000)
male	-7.276***	0.412	-9.094***	-3.910***	-17.548***	-7.300***	-6.630***	-2.152***	0.990***
	(0.847)	(0.351)	(0.469)	(0.599)	(1.564)	(0.350)	(1.049)	(0.495)	(0.107)
completed second.	-5.089***	-3.259***	-5.043***	-7.093***	-17.144***	-5.672***	-7.143***	-3.264***	-3.513***
	(0.998)	(0.685)	(0.644)	(0.814)	(1.893)	(0.441)	(1.370)	(0.696)	(0.242)
above secondary	-8.959***	-3.601***	-8.512***	-5.754***	-21.114***	-6.423***	-6.168***	-3.924***	-3.780***
	(1.373)	(0.569)	(0.667)	(0.921)	(2.052)	(0.654)	(1.445)	(0.712)	(0.225)
employee	-9.215***	-6.809***	-18.382***	-8.371***	-19.180***	-17.412***	-11.250***	-10.049***	-4.788***
	(1.007)	(0.482)	(0.582)	(0.738)	(1.867)	(0.463)	(1.311)	(0.710)	(0.159)
presence of partner	-1.294	-5.591***	-3.798***	-7.914***	-	-5.564***	-8.594***	-6.619***	-2.999***
	(1.012)	(0.421)	(0.617)	(0.914)	-	(0.461)	(1.456)	(0.669)	(0.134)
household size	0.493	-1.482***	-1.658***	-1.658***	-0.464	-0.650***	-3.105***	-0.013	-0.236***
	(0.381)	(0.220)	(0.215)	(0.512)	(0.905)	(0.181)	(0.715)	(0.336)	(0.085)
number of children	-0.579	1.163***	2.757***	2.904***	0.238	1.694***	6.566***	0.545	0.038
	(0.702)	(0.280)	(0.318)	(0.567)	(1.197)	(0.246)	(0.846)	(0.400)	(0.097)
weekday	4.911***	1.793***	3.738***	2.112***	-0.112	2.508***	9.468***	6.506***	0.314***
	(0.668)	(0.376)	(0.487)	(0.454)	(1.749)	(0.284)	(0.638)	(0.358)	(0.095)
constant	83.578***	31.850***	55.348***	53.223***	85.899***	46.174***	73.386***	38.314***	11.761***
	(3.297)	(1.611)	(1.775)	(2.959)	(9.712)	(1.171)	(3.750)	(1.842)	(0.510)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.061	0.043	0.135	0.070	0.151	0.190	0.109	0.067	0.028
N. individuals	10,450	28,384	34,652	20,366	3,467	76,640	22,538	28,581	171,881

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel. Composition of the sample by country is detailed in Table A.1 of Appendix. Dependent variable is the proportion of time travelled by physical mode. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Robust standard errors clustered at the individual level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

Table 7. Urban determinant of the proportion of time travelled by public transport, by country

	Canada	Spain	Hungary	Italy	NL	UK	US
urban	5.682***	5.858***	1.503	1.189***	1.597***	3.758***	2.272***
	(0.241)	(0.309)	(0.980)	(0.183)	(0.615)	(0.668)	(0.084)
age	-0.462***	-0.444***	-0.648**	-0.337***	-0.424***	-0.048	-0.110***
	(0.052)	(0.054)	(0.260)	(0.029)	(0.098)	(0.082)	(0.018)
age squared	0.003***	0.004***	0.007***	0.003***	0.003***	0.001	0.001***
	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)	(0.001)	(0.000)
male	-0.539*	-3.898***	-2.994***	-1.011***	-1.110**	-0.749	0.466***
	(0.291)	(0.327)	(0.994)	(0.195)	(0.547)	(0.472)	(0.089)
completed secondary	-3.356***	1.774***	0.955	1.251***	5.038***	-0.942*	-3.541***
	(0.487)	(0.431)	(1.196)	(0.229)	(0.696)	(0.556)	(0.181)
above secondary	-1.957***	1.161***	1.077	2.038***	6.480***	-0.413	-3.280***
	(0.425)	(0.438)	(1.382)	(0.370)	(0.749)	(0.604)	(0.173)
employee	-1.481***	-0.144	7.144***	-2.197***	-1.178*	-2.383***	-0.624***
	(0.376)	(0.385)	(1.093)	(0.230)	(0.675)	(0.669)	(0.111)
presence of partner	-3.675***	-4.127***	-	-2.913***	-7.004***	-6.647***	-2.319***
	(0.330)	(0.423)	-	(0.236)	(0.807)	(0.683)	(0.107)
household size	0.135	0.696***	0.370	0.217**	1.550***	0.948***	-0.012
	(0.196)	(0.161)	(0.550)	(0.098)	(0.470)	(0.330)	(0.071)
number of children	-0.834***	-1.741***	-1.384*	-0.020	-2.877***	-1.546***	-0.206**
	(0.226)	(0.222)	(0.707)	(0.137)	(0.503)	(0.376)	(0.083)
weekday	4.541***	5.379***	2.048*	3.419***	2.901***	1.582***	1.791***
	(0.266)	(0.295)	(1.054)	(0.143)	(0.360)	(0.342)	(0.070)
constant	17.441***	18.008***	18.057***	12.712***	13.771***	9.169***	8.215***
	(1.357)	(1.266)	(6.272)	(0.653)	(2.197)	(1.724)	(0.486)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.058	0.055	0.020	0.049	0.065	0.030	0.029
N. individuals	28,384	34,652	3,467	76,640	22,538	15,051	170,645

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel and urban location. Bulgaria, France and the UK (2005; 2014-2015) do not have urban/rural information. Dependent variable is the proportion of time travelled by public transport. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Robust standard errors clustered at the individual level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 7. Urban determinant of the proportion of time travelled by physical mode, by country

	Canada	Spain	Hungary	Italy	NL	UK	US
urban	1.102***	4.624***	-0.520	-1.046***	6.994***	8.378***	2.038***
	(0.400)	(0.496)	(1.670)	(0.349)	(1.227)	(1.140)	(0.126)
age	-0.293***	-0.117	-0.344	-0.288***	-0.915***	-0.056	0.144***
	(0.071)	(0.081)	(0.403)	(0.057)	(0.189)	(0.127)	(0.023)
age squared	0.002**	0.005***	0.004	0.009***	0.009***	-0.000	-0.002***
	(0.001)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.000)
male	0.419	-9.027***	-17.546***	-7.299***	-6.532***	-3.073***	0.975***
	(0.351)	(0.469)	(1.565)	(0.350)	(1.045)	(0.713)	(0.108)
completed secondary	-3.343***	-5.316***	-17.080***	-5.635***	-7.353***	-1.900**	-3.472***
	(0.687)	(0.643)	(1.911)	(0.441)	(1.365)	(0.895)	(0.243)
above secondary	-3.772***	-9.186***	-20.986***	-6.338***	-6.736***	-5.759***	-3.941***
	(0.573)	(0.669)	(2.107)	(0.654)	(1.437)	(0.943)	(0.227)
employee	-6.817***	-18.279***	-19.151***	-17.403***	-11.029***	-10.060***	-4.775***
	(0.482)	(0.581)	(1.870)	(0.463)	(1.306)	(1.012)	(0.160)
presence of partner	-5.531***	-3.715***	-	-5.544***	-8.553***	-8.844***	-2.925***
	(0.421)	(0.616)	-	(0.461)	(1.445)	(1.005)	(0.135)
household size	-1.494***	-1.614***	-0.491	-0.689***	-2.807***	0.364	-0.274***
	(0.220)	(0.215)	(0.910)	(0.182)	(0.709)	(0.479)	(0.085)
number of children	1.181***	2.708***	0.243	1.703***	6.453***	1.050*	0.078
	(0.280)	(0.317)	(1.197)	(0.246)	(0.839)	(0.562)	(0.098)
weekday	1.803***	3.647***	-0.106	2.505***	9.493***	9.144***	0.323***
	(0.376)	(0.487)	(1.750)	(0.284)	(0.638)	(0.498)	(0.096)
constant	31.047***	52.208***	86.368***	46.943***	67.265***	25.109***	10.279***
	(1.625)	(1.800)	(9.821)	(1.197)	(3.926)	(2.652)	(0.514)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.043	0.137	0.151	0.190	0.113	0.079	0.030
N. individuals	28,384	34,652	3,467	76,640	22,538	15,051	170,645

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel and urban location. Dependent variable is the proportion of time travelled by physical mode. Estimated coefficients are multiplied by 100. All regressions include year fixed effects. Robust standard errors clustered at the individual level in parentheses.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

Appendix

Table A.1. Sample Composition

country	survey years	number of individuals	number of travel episodes
Bulgaria	2001-2002	10,450	31,358
Canada	2005 and 2010	28,384	108,505
Spain	2002-2003 and 2009-2010	34,652	122,540
France	2010	20,366	59,539
Hungary	2009-2010	3,467	12,230
Italy	2002-2003 and 2008-2009	76,640	348,651
Netherlands	2000 and 2005	22,538	75,032
UK	2000-2001; 2005 and 2014-2015	28,581	105,199
US	2003 to 2019	171,881	764,128
All countries	2000 to 2019	396,959	1,627,182

Note: Sample consists of individuals from the Multinational Time Use Study (MTUS) from 2000 to 2019, including all travel episodes with non-missing information on mode of travel.