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DISCUSSION PAPER SERIES

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ABSTRACT

Teleworking and Travel Purposes: UK Evidence after the COVID-19 Pandemic*

Telework has gained increasing popularity in recent years, particularly following the COVID-19 pandemic, and is often considered a work practice that contributes to environmental sustainability by reducing commuting trips. However, the existing literature presents mixed findings regarding its potential effects on other types of travel, such as leisure and personal care trips. This paper examines the relationship between telework and daily travel time, utilizing data from the 2023 Extended Light Diary Digital Instrument (ELiDDI) survey, a nationally representative time use survey conducted in the UK in March 2023. Our findings indicate that teleworkers spend fewer minutes (e.g., 61 minutes) traveling per day compared to those working away from home, a result that remains robust even after excluding daily commuting time, suggesting that telework may lead to significant daily travel time savings. Further exploration reveals that telework is primarily related to reduced travel time for personal and housework-related activities, particularly among male teleworkers. These findings suggest that promoting telework policies could be an effective strategy not only for reducing commuting trips but also for achieving broader reductions in daily travel time, which may contribute to sustainability goals in the transportation sector and alleviate transportation-related environmental impacts.

JEL Classification: J21, J22, R41

Keywords: daily travel time, travel purposes, telework, time use, ELiDDI data, COVID-19

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1. Introduction

The COVID-19 pandemic brought about significant disruptions across all sectors of society, with the labor market being particularly affected. To reduce the spread of the virus, many firms were forced to quickly restructure their operations, implementing remote work wherever feasible, which led to a dramatic surge in its adoption as businesses sought to maintain continuity for the first time on such a large scale. After the pandemic, working from home practices have continued to play a major role in many occupations (Barrero et al., 2023). This paradigm shift has brought some benefits, such as increased work-life balance (Del Boca et al., 2020; Laß and Wooden, 2023; Inoue et al., 2024), increased well-being (Kroesen, 2022; Tahlyan et al., 2022; Tao et al., 2023) or greater work performance (Bloom et al., 2015; Pabilonia and Vernon, 2022; Deole et al., 2023; Angelici and Profeta, 2024; Burdett et al., 2024; Inoue et al., 2024).

Telework offers significant environmental benefits, serving as a viable strategy to reduce travel demand, energy consumption, and air pollution. Aksoy et al. (2023) emphasize that telework is associated with reduced commuting time, detailing the time savings linked to remote work and their reinvestment across various countries. In this context, flexible working arrangements are regarded as an effective means of mitigating the environmental impact of commuting by decreasing the time spent traveling to and from the workplace—a substantial component of daily travel—and alleviating traffic congestion for those who still commute. Although assessing the true climate benefits of teleworking is complex, recent research by Wu et al. (2024) indicates that working from home can reduce greenhouse gas emissions by 29% compared to traditional office work, based on data from the 2021 American Time Use Survey (ATUS).

However, the time savings derived from telework as a consequence of commute reduction might be offset if the reduction in commuting time leads to an increase in non-work-related travel or additional travel via slower modes of transport. If the additional time gained from teleworking is reallocated to other types of travel, it could diminish the environmental benefits of telework, effectively offsetting the reduction in commuting time. For example, Gimenez-Nadal et al. (2024) suggests that a significant portion of non-work trips is often combined with daily commutes (e.g., trip chains), particularly those made from work to home among female workers. However, when working remotely, the absence of these trip chains may result in increased non-work-related travel, potentially altering the overall environmental impact. Conversely, other studies indicate that telework is associated with an increased reliance on active and public modes of transport (de Abreu e Silva and Melo, 2018; Chakrabarti, 2018; Lachapelle et al., 2018; Elldér, 2020, 2022; Caldarola and Sorrell, 2022; Wöhner, 2023). This shift in travel patterns may lead to an extension of non-commuting travel time for workers who work at home.

Within this framework, the aim of this paper is to examine the travel behavior by workers who telework relative to their counterparts who work away from home, with a focus on daily travel time. To do so, we use data from the Extended Light Diary Digital Instrument (ELiDDI), a nationally representative time use survey conducted in the UK in March 2023. The use of recent survey data strengthens the validity of the findings from this work, as research based on older data may not accurately reflect current teleworking trends.

The results indicate that teleworking is associated with a significant reduction in daily travel time. Specifically, teleworkers spend 61 fewer minutes traveling per day compared to those who work away from home. Moreover, our analysis indicates that teleworking is related to an 11-minute reduction in daily non-work-related travel. These estimates vary by travel purpose, demonstrating a negative relationship between telework and the time spent traveling for leisure and housework-related activities. Finally, our findings show that telework is associated with a more significant reduction in daily travel time for men compared to female workers. This result supports the household responsibility hypothesis (Gimenez-Nadal and Molina, 2016), which suggests that women's commuting patterns are constrained by both temporal and spatial factors, thereby reducing the potential time savings telework could offer. Furthermore, telework is associated with a larger reduction in non-work-related travel among men, while female teleworkers may not substitute housework-related travel.

The contributions of this paper are threefold. First, we analyze compensation effects from telework using a nationally representative survey recently conducted in the UK, capturing current telework practices on a sample of workers. Prior research predominantly focuses on data from the pre-pandemic period (Melo and de Abreu e Silva, 2017; de Abreu e Silva and Melo, 2018; Budnitz et al., 2020; Elldér, 2020; Caldarola and Sorrell, 2022; Wöhner, 2022, 2023) or early stages of the pandemic until 2021 (Restrepo and Zeballos, 2022; Faber et al., 2023; Obeid et al., 2024), resulting in findings that may not be fully applicable to inform the present context. In this context, the utilization of data reflecting current telework rates, which are higher and more stable, helps to mitigate the systematic differences between teleworkers and non-teleworkers found in pre-pandemic studies (Obeid et al., 2024). Our results contrast with previous research that indicates working from home is associated with increased travel time and more travel for non-work purposes (Zhu, 2012; de Abreu e Silva and Melo, 2018; Zhu et al., 2018; Budnitz et al., 2020; Caldarola and Sorrell, 2022; Wöhner, 2022; Faber et al., 2023).

Second, our data allows for a comprehensive analysis of travel demands among teleworkers, precisely distinguishing travel patterns based on trips purposes, such as personal, leisure, housework, childcare, and education. This aspect has not been thoroughly explored in the existing literature, which predominantly focuses on total distance travelled and travel time (Zhu, 2012; Melo and de Abreu e Silva, 2017; de Abreu e Silva and Melo, 2018; Elldér, 2020; Caldarola and Sorrell, 2022; Wöhner, 2022; Faber et al., 2023; Obeid et al., 2024), commuting duration and distance (Zhu, 2012, 2013; Melo and de Abreu e Silva, 2017; Restrepo and Zeballos, 2022; Wöhner, 2022; Faber et al., 2023;), or specific transport mode use (de Abreu e Silva and Melo, 2018; Lachapelle et al., 2018; Elldér, 2020, 2022; Caldarola and Sorrell, 2022; Wöhner, 2022, 2023).

To the best of our knowledge, only a few studies, including Zhu (2012), Caldarola and Sorrell (2022), Wöhner (2022), Faber et al. (2023), and Motte-Baumvol and Schwanen (2024), have distinguished total travel distance and duration based on trip purposes. These studies primarily focus on distinguishing between work-related and non-work-related trips. In this context, data from time use surveys are generally preferred over those from direct questions. Self-reported diary approaches, which document activities across a 24-hour period, are widely regarded as the gold standard for accuracy and reliability. This is due to their short recall period and their ability to minimize social desirability and aggregation biases (Barrett and Hamermesh, 2019; Gershuny et al., 2020; Sullivan et al., 2021; Gimenez-Nadal and Molina, 2022).

Third, we examine whether the relationship between teleworking and travel demands differs by gender, an area that remains insufficiently understood. Research has consistently shown that women have shorter commuting times than men. According to the household responsibility hypothesis (Gimenez-Nadal and Molina, 2016), women tend to choose jobs closer to home to fulfil their household responsibilities. Gimenez-Nadal et al. (2022) provide a recent cross-country analysis of the gender gap in commuting time across Europe, revealing that trends in this gap varied among different country groups between the 1990s and 2010s. To the best of our knowledge, Pabilonia and Vernon (2022) and Rüger et al. (2024) are the only studies that examine the offsetting effects of telework, focusing on daily commuting time and gender heterogeneities, using US and Australian data from the pre-pandemic period (2017-2018 vs. 2002-2019). Consistent with Pabilonia and Vernon (2022) and Rüger et al. (2024), our analysis reveals gender differences in the relationship between telework and travel demands. Telework is associated with diminished travel demands among men, whereas no significant relationship is observed among women. Specifically, women do not spend less time on non-work-related travel on days they telework, indicating that commuting trips are combined with other travel purposes, such as housework-related travel. This finding is in line with prior research, which shows that female teleworkers often use commuting time savings for additional household production (Pabilonia and Vernon, 2022) or engage in intermediate activities while traveling between work and home (Gimenez-Nadal et al., 2024). Consequently, from a travel perspective, teleworking may not help reduce the gender gap in household responsibilities.

The remainder of the paper is organized as follows. Section 2 provides a literature review. Section 3 details the data, sample selection and variables. Section 4 explains the econometric strategy, while Section 5 presents the results. Finally, Section 6 concludes the paper.

2. Literature review

This paper contributes to the transportation literature by examining the offsetting effects of teleworking. A long-standing question in this field is whether teleworking acts as a substitute for travel, resulting in a reduction in travel demand, or as a complement, leading to an increase in travel. This issue has garnered renewed attention in light of the rising teleworking rates across various occupations during the pandemic.

For instance, Zhu (2012) finds teleworking is positively correlated with commute distances and durations, as well as with the frequency, duration, and distance of both work-related and non-work-related trips. These results align with Zhu et al. (2018). Similarly, Zhu (2013) shows that telecommuting is associated with longer commuting distances and durations for both one-worker and two-worker households, based on data from the 2001 and 2009 National Household Travel Surveys (NHTS). Studies by Melo and de Abreu e Silva (2017), de Abreu e Silva and Melo (2018), Budnitz et al. (2020), Caldarola and Sorrell (2022), and Motte-Baumvol and Schwanenen (2024), using the National Travel Survey (NTS) data from Great Britain and England, further support these findings.

Specifically, Melo and de Abreu e Silva (2017) and de Abreu e Silva and Melo (2018) show longer weekly commuting distances and higher household weekly travel by all modes, particularly by car, for more frequent teleworkers, whereas Budnitz et al. (2020) show that the probability of taking trips for purposes other than commuting, such as business, escort or leisure trips, is higher for individuals who telecommute. Conversely, Lachapelle et al. (2018) use time use diary data from the 2005 Canadian General Social Survey and show that teleworking is associated with an average reduction of 13 minutes in overall travel time, and Elldér (2020) shows that teleworkers are more likely not to travel than those who do not telework at all or telework part-time throughout the day, whereas they make fewer trips and travel shorter distances than do those who do not telework, using data from the Swedish NTS from 2011 to 2016.

Recently, Wöhner (2022) uses data from the 2015 Swiss Mobility and Transport Microcensus and finds that full-time teleworkers reduce their vehicles kilometers traveled and distance covered with all modes of transport by 31.2 and 37.1 percent, respectively, whereas hybrid workers travel 21.5 percent more with all modes of transport and the distance they cover by motorized private transport for non-work purposes is 16.3 percent greater. Accordingly, saved commutes among hybrid workers are offset with non-work trips, resulting in a zero—neutral—impact of hybrid work on total mobility. Besides, Rüger et al. (2024) use panel data from the Household, Income and Labour Dynamics in Australia (HILDA) from 2002 to 2019 and obtain that doing any work from home is associated with an average reduction of 14 percent in total commuting time for the pooled sample, and a larger reduction is observed among female compared to male home workers.

A limited number of studies have focused on the early stages of the pandemic. Faber et al. (2023) utilize panel data from the Netherlands Mobility Panel covering the years 2017 to 2021, finding that working from home has a negative impact on commuting time both before and during the pandemic. Moreover, the net effect of working from home on total travel time is negative in both periods. Conversely, Obeid et al. (2024) analyze US data from January 2020 to December 2021 and panel data regression models, finding a positive relationship between teleworking and the number of non-commute trips, while a negative relationship is observed for total daily distance traveled. Additionally, a day of teleworking is associated with one additional non-commute trip. This suggests that the non-commute trip is, on average, shorter than the two-way commute trip.

3. Data and variables

3.1. Data

We utilize time diary data from the Extended Light Diary Digital Instrument (ELiDDI) survey, a nationally representative time use survey encompassing the entire UK population. The ELiDDI is the most recent time use survey developed by the Centre for Time Use Research (CTUR) in March 2023. The primary instrument of Time Use Surveys (TUS) is the time diary, where respondents report their activities for each minute of the day preceding the interview, referred to as the "diary day" in TUS lexicon (see Gimenez-Nadal and Molina (2022) for a comprehensive overview of TUS).

In the ELiDDI survey, respondents are asked to complete a time diary online, either on a desktop or smartphone, for two different diary days—one for a weekday and one for a weekend day. The time use diaries range from 4 a.m. to 4 a.m. the following day, thus covering a full 24-hour period. Respondents, one person per household, report both main and secondary activities (if any) for each interval based on a range of pre-coded activities, including start and finish times. Additional activity details recorded in the survey include device usage (e.g., computer, tablet, or smartphone), activity location (e.g., home, work, school/college, others' home, restaurants, or shops), mode of transport, co-presence, and the associated instantaneous enjoyment level for each activity on a 7-point Likert scale.

3.2. Sample selection

For the purposes of this analysis, we restrict the sample to individuals who are employed, including both employees and self-employed workers, and focus solely on working and typical diary days, thereby avoiding potential bias from atypical days. Working days are defined as diary days where individuals allocated at least 60 minutes to market work activities, excluding commuting time.[1] Naturally, we exclude any observations with missing information on the variables of interest. These restrictions result in a final sample

[1] There are 120 activity codes available from the ELiDDI and we consider paid job (primary activity code 171) and other activities related to employment (primary activity code 172) as market work activities.

of 758 observations from 675 individuals (see Table A1 in Supplementary material for a detailed description of the total individuals and observations retained after each sample restriction).

3.3. Variables

From the diary structure of the ELiDDI, we define daily travel time based on the primary activities reported by respondents. Specifically, we classify the following categories as travel activities; 111 "travelling: walking, jogging", 112 "travelling: cycle", 113 "travelling: in own car", 114 "travelling: public transport", 115 "travelling: other", 116 "travelling: taxi, Uber, Lyft", and 117 "travelling: motorbike, moped". The total time spent on all these primary activities is summed to represent the total daily travel time, measured in minutes.

Furthermore, leveraging the data on subsequent non-travel activities, including specific details such as activity location between the trips, we extend our analysis beyond merely assessing total daily travel time. Instead, we classify daily travel time according to distinct purposes, in line with methodologies commonly used in previous studies using TUS (Kimbrough, 2019; Gimenez-Nadal et al., 2021, 2024). Within this framework, we differentiate between time spent traveling for various purposes, such as commuting to/from work, and time spent traveling for personal, leisure, housework, childcare, or education activities.

For example, commuting time is defined as any travel episode that precedes a paid job activity performed outside the home, or any travel episode that involves returning home from work. If a respondent indicates that the activity following a travel episode involved assisting an adult person, shopping, or managing household tasks, we classify the travel purpose as housework. Conversely, if the subsequent activity involved accompanying or playing with a child, the travel episode is classified as childcare. Travel associated with activities such as dining out, socializing, or participating in fitness activities is categorized as leisure travel, whereas travel episodes followed by appointments with services such as doctors, dentists or hairdressers are classified as personal travel. Lastly, we categorize travel related to attending classes or lectures as educational travel. For activities performed at home following a travel episode, the travel purpose is assigned to the activity that prompted the return trip, as previously explained.

We also utilize the diary of the survey to define the variable of interest for the analysis, representing teleworkers. This variable indicates workers who telework during the diary day and is defined using information regarding the location of each paid job episode through a dummy variable that takes the value of 1 for those workers who do all their paid job episodes at home, and 0 otherwise (Gimenez-Nadal and Velilla, 2024a, 2024b).

The ELiDDI also conducts a demographic questionnaire that supplements the time diary and records basic socio-demographic factors like age, sex, marital status, education, family income, or region. We utilize this questionnaire to define other explanatory variables relevant to the daily travel time and potentially correlated with the telework variable. This approach is substantiated by existing literature (Melo and de Abreu e Silva, 2017; de Abreu e Silva and Melo, 2018; Elldér, 2020, 2022; Caldarola and Sorrell, 2022; Wöhner, 2022, 2023; Cowan, 2024) and enables us to additionally control for the observed heterogeneity of individuals. These variables encompass gender, age at the time of the interview, native citizen status, maximum educational level attained, self-employment status, hours normally worked per week, marital status, household size, number of children, and family income.

For gender, we include a dummy variable that designates male respondents (with females serving as the reference category). Age at the time of the interview is provided by the survey in intervals of 10-year age brackets (from 18 to 70 or older), with those aged more than 70 years old being considered as the reference category. We also define a dummy variable that designates UK citizens with 0 otherwise. The highest level of education is categorized into five different levels: basic qualification, high school, apprenticeship, undergraduate degree, or higher degree (reference category: no qualifications). The self-employment status of respondents is controlled through a dummy variable that takes the value of 1 for self-employed workers with 0 employees or between 1-25 employees, 0 otherwise. We also define the weekly number of hours usually worked (Faber et al., 2023; Rüger et al., 2024). To control for household characteristics, we additionally include marital status through a dummy variable that takes the value of 1 for those married or living with a partner, 0 otherwise, household size, the number of children in the household, and annual family income after taxes and/or deductions.[2]

[2] This income information is provided by the survey in 11 different income brackets to minimize missing values, as is frequent in TUS, and we fix the midpoint of the interval and the upper (lower) point for the first (last) interval.

3.4. Summary statistics

Table 1 presents the summary statistics of the main variables for our sample using survey weights, providing a comprehensive overview of the travel patterns and teleworking prevalence among the surveyed population, along with their individual and household characteristics. On average, workers devote 54 minutes per day to travel activities. When excluding commuting time, the average daily travel time is 17.64 minutes. The breakdown of travel time includes personal travel, which accounts for 2.74 minutes; leisure travel, which takes up 8.28 minutes; housework-related travel, which comprises 5.25 minutes; childcare-related travel, which consists of 1.34 minutes; and education-related travel, which is 0.04 minutes.

Regarding our variable of interest from the analysis, about 27.2 percent of respondents engage in teleworking during the day.[3] In terms of individual characteristics, more than half of the respondents are male, with the sample consisting of approximately 54 percent male respondents on average. The age distribution of the sample is as follows: 24.2 percent are aged 18-29, 23.2 percent are 30-39, 23.3 percent are 40-49, 20.6 percent are 50-59, 7.6 percent are 60-69, and 1 percent are 70 years or older. Native citizens constitute 89.7 percent of the sample.

In terms of education attainment, 1.2 percent have no qualifications, 20.6 percent have basic qualifications, 19.8 percent have completed high school, 7.5 percent have apprenticeship qualifications, 26.2 percent hold an undergraduate degree, and 24.7 percent possess a higher degree. Additionally, 9.1 percent of respondents are self-employed and work on average 36.73 hours per week.

Regarding household structure, 77.1 percent of respondents are married or cohabiting with a partner. The average household size is 2.86 members, with an average of 0.67 children per household. Finally, the average annual family income is £46,778.84.

[3] In our robustness checks, we also validate our findings using alternative definitions of telework (Gimenez-Nadal and Velilla, 2024a, 2024b). When teleworkers are defined as those who spend at least 60 minutes on paid job at home, the sample mean of teleworkers is 35.7 percent. Alternatively, if teleworkers are defined as those who complete all their paid job episodes or at least 60 minutes of their paid job at a location other than the workplace, the sample means are 31.2 and 36.9 percent, respectively.

4. Econometric strategy

To examine the relationship between telework and daily travel time, we estimate linear regression models using the Ordinary Least Squares (OLS) estimator, controlling for other observable factors that may influence the daily travel time of workers and potentially correlated with teleworking. Specifically, we estimate the following equation for each worker i in day t by OLS:

$$Y_{it} = \alpha + \beta_1 Telework_{it} + X_i'\gamma + \mu_t + \eta + \varepsilon_{it} \tag{1}$$

The dependent variable Y_{it} represents various measures of travel time (in minutes per day), capturing total daily travel time, daily travel time excluding commuting time, and daily travel time for specific purposes such as personal travel, leisure, housework, childcare, and education. $Telework_{it}$ is a dummy variable that takes the value 1 if worker i in day t only worked from home, and 0 otherwise. Thus, the reference category refers to workers who worked away from home, either part- or full-day. X_i represents a vector of individual characteristics of respondent i that consists of gender, age groups (ref.: 70+), native citizen, educational level attainment (ref.: no qualifications), self-employment status (ref.: employee), usual hours worked per week, cohabitation status, household size, number of children, the log of family income, and occupation dummies (ref.: higher managerial, professional, or administrative).

The parameter of interest in Eq. (1) is β_1, which measures the additional or fewer daily minutes teleworkers spent traveling compared to those who work away from home or do not telework for the full day, while controlling for observed heterogeneity captured by X_i. Given the prominence of commuting time in overall travel demand, we expect the coefficient β_1 to be negative, assuming no complementary effects. This would indicate that teleworking is associated with a reduction in the daily travel time of workers.

By accounting for occupation fixed effects, we control for occupation-specific heterogeneity in commuting behavior and capture systematic differences in teleworking adoption across jobs, as workers in certain occupations have a higher propensity to telecommute and not every job is equally suitable for telework (He and Hu, 2015). Additionally, to control for varying telework schedules throughout the week (Motte-Baumvol et al., 2024; Obeid et al., 2024), we include day-of-week dummy variables, μ_t

(ref.: Saturday). We also incorporate region dummy variables, η (ref.: Northern Ireland), to control for different regional characteristics in the adoption of telework and transport networks across regions (Zhu et al., 2018), with the region sub-index being omitted for the sake of simplicity.[4]

Finally, ε_{it} denotes the error term of the regression equation, and we cluster the standard errors at the individual level to account for potential heteroskedasticity and arbitrary correlation of the error term within individuals (Cameron and Miller, 2015). This approach captures variations in travel patterns over the week, as individuals may be observed for a maximum of two diary days in our sample, thus avoiding underestimation of the standard errors. All the estimates include sample weights provided by the ELiDDI.[5]

5. Results

5.1. Total daily time spent traveling

Table 2 presents the results from estimating Equation (1) on the daily time spent traveling, both with and without the inclusion of daily commuting time. The findings indicate that telework is linked to a reduction in daily travel time, even after excluding daily commuting time. This suggests that the commute times saved by working from home are not compensated by additional time traveling for other purposes per day. Consequently, workers do not spend additional time traveling on days when they telework.

In Column (1) of Table 2, we observe a negative relationship between telework and daily travel time, with teleworkers spending approximately 61.37 fewer minutes per day on travel activities compared to similar workers who work away from home, either part- or full-day. When commuting time is excluded in Column (2), telework remains associated with a reduction in daily travel time of about 11 minutes. This indicates that workers do not allocate additional time to other travel purposes on days when they work exclusively from home, compared to their counterparts who work away from home.

[4] The ELiDDI allows us to define dummies identifying the following 12 regions: “North East”, “North West”, “Yorkshire and The Humber”, “East Midlands”, “West Midlands”, “East of England”, “London”, “South East”, “South West”, “Wales”, “Scotland”, and “Northern Ireland”.

[5] Estimates were calculated using Tobit regression models to account for censoring of dependent variables at zero minutes (Tobin, 1958). The conclusions remain identical as for the OLS estimates, in line with the existing literature on time allocation (Frazis and Stewart, 2012; Gershuny, 2012; Foster and Kalenkoski, 2013) and are available upon request.

In summary, we find a negative association between full-day telework and daily time spent traveling. The robustness of this relationship, even after excluding a significant component of daily travel such as commuting, suggests that workers do not compensate for the reduced commute time by increasing travel for other purposes on telework days. This finding indicates that there are no compensation effects associated with teleworking and contrasts with some existing literature (Zhu, 2012; Melo and de Abreu e Silva, 2017; Caldarola and Sorrell, 2022; de Abreu e Silva and Melo, 2018; Zhu et al., 2018; Budnitz et al., 2020; Wöhner, 2022; Faber et al., 2023).

5.2. Total daily time spent for travel purposes

Table 3 presents estimates from Equation (1) regarding daily time spent traveling for various purposes. The results indicate that teleworking is associated with a reduction in daily travel time for personal and housework-related activities. However, no significant estimates are observed for travel related to leisure, childcare, or education. This implies that the overall estimates on daily non-work-related travel vary by travel purpose.

Specifically, Column (1) shows that teleworkers spend approximately 4.05 fewer minutes per day on personal travel compared to those who work away from home. Additionally, Column (3) indicates that teleworkers spend 4.89 fewer minutes per day on travel related to housework activities, in comparison to their counterparts who work away from home. In contrast, no significant estimates are observed for travel associated with leisure, childcare, or education.

These findings suggest that the estimates of teleworking on daily travel time, as previously documented in Table 2, vary across different types of travel, and that telework is not uniformly related to all non-work-related travel purposes. This observation aligns with prior research indicating no neutral effects of teleworking on non-work-related travel (Zhu, 2012; Zhu et al., 2018; Caldarola and Sorrell, 2022; Wöhner, 2022; Faber et al., 2023; Motte-Baumvol and Schwanen, 2024). However, a limitation of this previous research is the lack of differentiation among non-work-related travel purposes, which may obscure significant variations by aggregating all such trips into a single category.

5.3. Robustness checks

We have conducted several robustness checks on the main estimates presented in Tables 2 and 3, with the results for the key telework coefficients shown in Table 4.

First, we exclude self-employed workers from the sample due to their distinct teleworking practices, to be consistent with previous studies (de Abreu e Silva and Melo, 2018; Lachapelle et al., 2018; Budnitz et al., 2020; Stiles and Smart, 2021; Caldarola and Sorrell, 2022; Pabilonia and Vernon, 2022). For instance, de Abreu e Silva and Melo (2018) find that being self-employed is associated with a higher teleworking frequency, whereas Budnitz et al. (2020) show that teleworkers are more likely to be self-employed. The results after applying this exclusion, presented in Panel A of Table 4, indicate that our main findings remain robust.

Next, we limit the sample to weekdays, excluding diary days for weekends, since travel and teleworking patterns can differ significantly on weekends, even when they are classified as working days. The findings, displayed in Panel B of Table 4, are consistent with our original results.

Finally, we applied the inverse hyperbolic sine transformation to our dependent variables, as shown in Panel C of Table 4. This transformation approximates the natural logarithm and is defined for all real numbers, allowing us to interpret the estimates for the telework variable as approximations of semi-elasticities. The results remain consistent, further reinforcing the robustness of our main findings.

We assess the robustness of our findings with respect to different definitions of telework in Table 5. Up to this point, our analysis has focused on the daily travel savings associated with full-day teleworking. However, the relationship of telework and travel demand may differ between full-day and part-day teleworking practices (Lachapelle et al., 2018; Elldér, 2020, 2022; Wöhner, 2022). For instance, workers who telework may divide their workday between remote and on-site activities, potentially leading to distinct patterns in travel behavior compared to those who telework for the entire day.

Panel A of Table 5 examines a definition of telework based on a dummy variable that equals 1 if workers spend at least 60 minutes on market work activities at home, and 0 otherwise (Gimenez-Nadal and Velilla, 2024a, 2024b). The results reveal a negative relationship between part-day teleworking and total daily travel time. However, this relationship is not statistically significant when daily commuting time is excluded from the analysis, as shown in Column (2). This finding suggests that the environmental consequences of part-day teleworking differ from those of full-day teleworking, aligning with expectations, and indicates that part-day teleworkers may engage in intermediate activities related to housework while commuting (Gimenez-Nadal et al., 2024).

In Panel B, we expand the definition of full-day telework to encompass any time spent on paid work outside the workplace, not limited to home-based telework. Telework includes working remotely from somewhere other than the workplace, mostly from home but also from other locations such as other people's home, restaurants, or cafes (Stiles and Smart, 2021), utilizing information technology. This panel presents results for a dummy variable that captures full-day telework under this expanded definition that also considers time spent on paid job outside work. The findings demonstrate that our results are robust to this alternative definition. Specifically, workers classified as engaging in full-day telework, as per this expanded definition, spend significantly less time on daily travel compared to their counterparts who work exclusively on-site. This reduction in daily travel time holds whether daily commuting time is excluded.

Finally, Panel C of Table 5 examines a different aspect of part-day teleworking. In this panel, the dummy variable for telework equals 1 if workers spend at least 60 minutes on market work activities at a location other than the workplace, and 0 otherwise (Gimenez-Nadal and Velilla, 2024a, 2024b). Similar to Panel A, the results indicate that part-day teleworkers spend fewer minutes on daily travel. However, this relationship is not robust when daily commuting time is excluded from the analysis.

5.4. Results by gender

The analysis so far has primarily examined the average relationships between telework and daily travel time for the pooled sample. The findings indicate that workers who telework spend significantly less time traveling per day compared to those who work away from home. However, this general observation raises important questions about underlying differences between demographic groups. Alternatively, we estimate Equation (1) separately for men and women in Table 6, acknowledging there are significant differences in time allocation (Aguiar and Hurst, 2007). Previous studies, such as Pabilonia and Vernon (2022) and Rüger et al. (2024), have highlighted gender-specific patterns in the relationship between telework and travel time in the US and Australia, respectively.

Table 6 presents the estimates of Equation (1) separately by gender. The findings reveal significant differences in the relationship between telework and travel patterns for men and women. Specifically, telework is associated with a greater reduction in travel demands for men compared to women. This result is consistent with existing literature, which notes that women generally have shorter commutes (Gimenez-Nadal et al., 2022). Additionally, our analysis shows that female teleworkers do not spend fewer minutes to travel for housework-related activities per day compared to their counterparts who work away from home. Instead, female teleworkers appear to primarily reduce personal trips.

Columns (1-2) of Table 6 indicate that female teleworkers spend approximately 45.42 fewer minutes per day traveling compared to their counterparts who work away from home, while male teleworkers spend 73.19 fewer minutes per day on travel compared to their counterparts who work away from home. Moreover, the coefficients for female and male teleworkers are statistically significantly different, as demonstrated by a Wald-type test of coefficient equality ($p = 0.002$). This suggests that the reduction in daily travel time between teleworkers and those who work away from home differs by gender. When daily commuting time is excluded in Columns (3-4), we find that male teleworkers spend 14.98 fewer minutes per day traveling than their counterparts who work away from home. In contrast, no significant relationship is observed for female teleworkers in Column (3). This finding implies that the substitution effects of telework may differ between men and women.

Columns (5-14) present additional estimates of the substitution effects of telework on different travel purposes, broken down by gender. Columns (5-6) show estimates for daily time spent traveling for personal purposes. These results suggest that female teleworkers spend 4 fewer minutes per day on personal travel compared to their counterparts who work away from home, while male teleworkers spend 5.18 fewer minutes per day on personal travel than their counterparts who work away from home. For other travel purposes, we find that male teleworkers spend 8.13 fewer minutes per day on travel for housework-related activities compared to those who work away from home. In contrast, no significant reductions in housework-related travel time are observed for females who telework in Column (9), suggesting that telework is not associated with housework-related travel savings for women.

Overall, we find that telework is associated with a more significant reduction in daily travel time for male workers compared to female workers. This observation is consistent with the gender-based commuting gaps suggested in existing research and implies that the travel time savings from telework may be less pronounced for women. Additionally, telework is associated with a reduction in daily travel time for other purposes, including personal and household-related trips, among men, indicating the absence of compensation effects. In contrast, teleworking is linked to a reduction in daily travel time for personal purposes among female teleworkers, while no significant relationship is observed for other travel purposes.

6. Conclusions

This paper examines the relationship between telework and the travel demands of workers in the UK. The compensation effects from telework have long interested transportation researchers and policymakers, yet existing evidence provides mixed findings regarding the travel patterns of teleworkers. Our analysis utilizes data from the Extended Light Diary Digital Instrument (ELiDDI) survey, a nationally representative time use survey conducted in the UK in March 2023. The use of recent data allows us to better address systematic differences arising from teleworkers and non-teleworkers, which are often present in studies relying on pre-pandemic data when telework was a less common practice. Moreover, the diary-based structure of the survey data enables us to distinguish between different types of travel based on their purpose.

We find that teleworkers spend less time traveling per day, a relationship that holds even after excluding daily commuting time, suggesting no offsetting effects from telework. Specifically, teleworkers spend 61 fewer minutes traveling per day than their counterparts who work away from home. When commuting time is excluded, we find that teleworkers spend 11 fewer minutes traveling per day than their counterparts who work away from home. However, this relationship varies by travel purpose, with teleworkers primarily reducing travel for personal and household-related activities. Finally, the findings indicate that the relationship between telework and travel demands varies by gender, and telework is related to a more significant reduction in travel demands among men. This outcome aligns with the shorter commuting times experienced by women, which limits the potential for travel time savings through telework.

Our results hold significant relevance for planners and policymakers. In the current context, where telework remains prevalent across various occupations, understanding its environmental implications through up-to-date data is essential. The findings suggest that telework can lead to substantial travel time savings for workers. This implies that telework could serve as a key tool for reducing overall travel demand. From a sustainability perspective, these reductions in travel time can contribute meaningfully to lowering greenhouse gas emissions associated with transportation, a sector responsible for a considerable share of global emissions. Policymakers can, therefore, consider promoting telework as part of broader climate and transportation policies aimed at reducing emissions and improving air quality.

Additionally, the evidence points to the differentiated impact of telework by gender, with men experiencing greater travel time savings than women. This highlights the need for policymakers to take a gender-sensitive approach when designing telework policies, ensuring that such policies do not inadvertently reinforce existing gender disparities in travel patterns or access to flexible working arrangements. For instance, supporting childcare and household responsibilities through targeted policies could enhance the potential for telework to reduce travel time more equitably across genders. Moreover, urban planners could integrate telework into transportation and land-use planning, such as promoting mixed-use developments that reduce the need for personal travel and enhance the benefits of working from home.

Finally, telework also has potential implications for public transportation systems. With reduced demand for commuting, transit authorities may need to adjust schedules and capacities to reflect changing patterns in ridership. Policymakers could leverage these shifts to redesign public transit services in ways that are more efficient and tailored to evolving mobility needs, such as focusing on non-peak hours or increasing services in suburban areas where telework is more common. In sum, telework offers a range of opportunities for policy interventions that could yield both environmental and social benefits, making it a critical consideration in future transportation and labor market policies.

Certain limitations of this analysis are worth noting. First, we are unable to completely isolate the relationship between telework and daily travel time from permanent individual heterogeneity. Although we observe up to two diary days per respondent, the specific criteria applied to our research question limit the analysis to primarily one diary day per respondent. As a result, we are unable to employ panel data regression models, which restricts our ability to account for unobserved individual heterogeneity in preferences or habits. This limitation may introduce bias into our estimates. Another limitation of our study lies in the fact that the definition of telework is based on time use information from a single diary day, and we lack information regarding the frequency of telework over a longer period, such as a week or month.

References

Aguiar, M., & Hurst, E. (2007). Measuring trends in leisure: The allocation of time over five decades. *The Quarterly Journal of Economics*, 122(3), 969-1006. https://doi.org/10.1162/qjec.122.3.969

Aksoy, C. G., Barrero, J. M., Bloom, N., Davis, S. J., Dolls, M., & Zarate, P. (2023). Time savings when working from home. *AEA Papers and Proceedings*, 113, 597-603. https://doi.org/10.1257/pandp.20231013

Angelici, M., & Profeta, P. (2024). Smart working: work flexibility without constraints. *Management Science*, 70(3), 1680-1705. https://doi.org/10.1287/mnsc.2023.4767

Barrero, J. M., Bloom, N., & Davis, S. J. (2023). The evolution of work from home. *Journal of Economic Perspectives*, 37(4), 23-49. https://doi.org/10.1257/jep.37.4.23

Barrett, G. F., & Hamermesh, D. S. (2019). Labor supply elasticities: Overcoming nonclassical measurement error using more accurate hours data. *Journal of Human Resources*, 54(1), 255-265. https://doi.org/10.3368/jhr.54.1.1216.8407R1

Bleviss, D. L. (2021). Transportation is critical to reducing greenhouse gas emissions in the United States. *Wiley Interdisciplinary Reviews: Energy and Environment*, 10(2), e390. https://doi.org/10.1002/wene.390

Bloom, N., Liang, J., Roberts, J., & Ying, Z. J. (2015). Does working from home work? Evidence from a Chinese experiment. *The Quarterly Journal of Economics*, 130(1), 165-218. https://doi.org/10.1093/qje/qju032

Böhnen, C., & Kuhnimhof, T. (2024). Working from home and commuter travel in Germany–panel data analysis of long-term effects. Tra*nsportation Research Part A: Policy and Practice*, 190, 104257. https://doi.org/10.1016/j.tra.2024.104257

Budnitz, H., Tranos, E., & Chapman, L. (2020). Telecommuting and other trips: an English case study. *Journal of Transport Geography*, 85, 102713. https://doi.org/10.1016/j.jtrangeo.2020.102713

Burdett, A., Etheridge, B., Tang, L., & Wang, Y. (2024). Worker productivity during Covid-19 and adaptation to working from home. *European Economic Review*, 104788. https://doi.org/10.1016/j.euroecorev.2024.104788

Caldarola, B., & Sorrell, S. (2022). Do teleworkers travel less? Evidence from the English National travel survey. *Transportation Research Part A: Policy and Practice*, 159, 282-303. https://doi.org/10.1016/j.tra.2022.03.026

Cameron, A. C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50(2), 317-372. https://doi.org/10.3368/jhr.50.2.317

Chakrabarti, S. (2018). Does telecommuting promote sustainable travel and physical activity?. *Journal of Transport & Health*, 9, 19-33. https://doi.org/10.1016/j.jth.2018.03.008

Cowan, B. (2024). Time use, college attainment, and the working-from-home revolution. *Journal of Population Economics*, 37(3), 60. https://doi.org/10.1007/s00148-024-01036-5

de Abreu e Silva, J., & Melo, P. C. (2018). Does home-based telework reduce household total travel? A path analysis using single and two worker British households. *Journal of Transport Geography*, 73, 148-162. https://doi.org/10.1016/j.jtrangeo.2018.10.009

Del Boca, D., Oggero, N., Profeta, P., & Rossi, M. (2020). Women's and men's work, housework and childcare, before and during COVID-19. *Review of Economics of the Household*, 18(4), 1001-1017. https://doi.org/10.1007/s11150-020-09502-1

Deole, S. S., Deter, M., & Huang, Y. (2023). Home sweet home: Working from home and employee performance during the COVID-19 pandemic in the UK. *Labour Economics*, 80, 102295. https://doi.org/10.1016/j.labeco.2022.102295

Echeverría, L., Gimenez-Nadal, J. I., & Molina, J. A. (2022). Who uses green mobility? Exploring profiles in developed countries. *Transportation Research Part A: Policy and Practice*, 163, 247-265. https://doi.org/10.1016/j.tra.2022.07.008

Elldér, E. (2020). Telework and daily travel: New evidence from Sweden. *Journal of Transport Geography*, 86, 102777. https://doi.org/10.1016/j.jtrangeo.2020.102777

Elldér, E. (2022). Active travel and telework in Sweden: Teleworkers walk more, but cycle less. *Transportation Research Part D: Transport and Environment*, 109, 103362. https://doi.org/10.1016/j.trd.2022.103362

Environmental Protection Agency (EPA) (2024). Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions 1990-2022. Available in: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101AKR0.pdf (accessed in July 2024).

Eurostat (2021). Passenger mobility statistics. Available in: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_mobility_statistics (accessed in July 2024).

Faber, R. M., Hamersma, M., Brimaire, J., Kroesen, M., & Molin, E. J. (2023). The relations between working from home and travel behaviour: a panel analysis. *Transportation*, 1-25. https://doi.org/10.1007/s11116-023-10401-4

Foster, G., & Kalenkoski, C. M. (2013). Tobit or OLS? An empirical evaluation under different diary window lengths. *Applied Economics*, 45(20), 2994-3010. https://doi.org/10.1080/00036846.2012.690852

Frazis, H., & Stewart, J. (2012). How to think about time-use data: what inferences can we make about long-and short-run time use from time diaries?. *Annals of Economics and Statistics*, 105(106), 231-245. https://doi.org/10.2307/23646463

Gershuny, J. (2012). Too many zeros: a method for estimating long-term time-use from short diaries. *Annals of Economics and Statistics*, 105(106), 247-270. https://doi.org/10.2307/23646464

Gershuny, J., Harms, T., Doherty, A., Thomas, E., Milton, K., Kelly, P., & Foster, C. (2020). Testing self-report time-use diaries against objective instruments in real time. *Sociological Methodology*, 50(1), 318-349. https://doi.org/10.1177/0081175019884591

Gimenez-Nadal, J. I., & Molina, J. A. (2016). Commuting time and household responsibilities: Evidence using propensity score matching. *Journal of Regional Science*, 56(2), 332-359. https://doi.org/10.1111/jors.12243

Gimenez-Nadal, J. I., & Molina, J. A. (2022). Time Use Surveys. In K. F. Zimmermann (eds), *Handbook of Labor, Human Resources and Population Economics*, Springer, 1-18. https://doi.org/10.1007/978-3-319-57365-6_270-1

Gimenez-Nadal, J. I., & Velilla, J. (2024a). Home-based work, time allocations, and subjective well-being: gender differences in the United Kingdom. *Empirica*, 51(1), 1-33. https://doi.org/10.1007/s10663-023-09590-z

Gimenez-Nadal, J. I., & Velilla, J. (2024b). Work from home, time allocations, and wellbeing: The impact of lockdowns. Preprint available in: https://doi.org/10.21203/rs.3.rs-4240566/v1

Gimenez-Nadal, J. I., Molina, J. A., & Velilla, J. (2021). Two-way commuting: Asymmetries from time use surveys. Journal of Transport Geography, 95, 103146. https://doi.org/10.1016/j.jtrangeo.2021.103146

Gimenez-Nadal, J. I., Molina, J. A., & Velilla, J. (2022). Trends in commuting time of European workers: A cross-country analysis. *Transport Policy*, 116, 327-342. https://doi.org/10.1016/j.tranpol.2021.12.016

Gimenez-Nadal, J.I., Molina, J.A. & Velilla, J (2024). Intermediate activities while commuting. Review of Economics of the Household, 22, 1185–1220. https://doi.org/10.1007/s11150-023-09684-4

He, S. Y., & Hu, L. (2015). Telecommuting, income, and out-of-home activities. *Travel Behaviour and Society*, 2(3), 131-147. https://doi.org/10.1016/j.tbs.2014.12.003

Inoue, C., Ishihata, Y., & Yamaguchi, S. (2024). Working from home leads to more family-oriented men. *Review of Economics of the Household*, 22(2), 783-829. https://doi.org/10.1007/s11150-023-09682-6

Kimbrough, G. (2019). Measuring commuting in the American Time Use Survey. *Journal of Economic and Social Measurement*, 44(1), 1-17. https://doi.org/10.3233/JEM-180459

Kroesen, M. (2022). Working from home during the corona-crisis is associated with higher subjective well-being for women with long (pre-corona) commutes. *Transportation Research Part A: Policy and Practice*, 156, 14-23. https://doi.org/10.1016/j.tra.2021.10.025

Lachapelle, U., Tanguay, G. A., & Neumark-Gaudet, L. (2018). Telecommuting and sustainable travel: Reduction of overall travel time, increases in non-motorised travel and congestion relief?. *Urban Studies*, 55(10), 2226-2244. https://doi.org/10.1177/0042098017708985

Laß, I., & Wooden, M. (2023). Working from home and work–family conflict. *Work, Employment and Society*, 37(1), 176-195. https://doi.org/10.1177/09500170221082474

Melo, P. C., & de Abreu e Silva, J. (2017). Home telework and household commuting patterns in Great Britain. *Transportation Research Part A: Policy and Practice*, 103, 1-24. https://doi.org/10.1016/j.tra.2017.05.011

Motte-Baumvol, B., & Schwanen, T. (2024). Telework, travel times, and peak hour avoidance in England: An overview using travel times across five weekdays. *Travel Behaviour and Society*, 34, 100668. https://doi.org/10.1016/j.tbs.2023.100668

Motte-Baumvol, B., Schwanen, T., & Bonin, O. (2024). Telework and the day-to-day variability of travel behaviour: The specificities of Fridays. *Transportation Research Part D: Transport and Environment*, 132, 104245. https://doi.org/10.1016/j.trd.2024.104245

Obeid, H., Anderson, M. L., Bouzaghrane, M. A., & Walker, J. (2024). Does telecommuting reduce trip-making? Evidence from a US panel during the COVID-19 pandemic. *Transportation Research Part A: Policy and Practice*, 180, 103972. https://doi.org/10.1016/j.tra.2024.103972

Pabilonia, S. W., & Vernon, V. (2022). Telework, wages, and time use in the United States. *Review of Economics of the Household*, 20(3), 687-734. https://doi.org/10.1007/s11150-022-09601-1

Restrepo, B. J., & Zeballos, E. (2022). Work from home and daily time allocations: evidence from the coronavirus pandemic. *Review of Economics of the Household*, 20(3), 735-758. https://doi.org/10.1007/s11150-022-09614-w

Rüger, H., Laß, I., Stawarz, N., & Mergener, A. (2024). To what extent does working from home lead to savings in commuting time? A panel analysis using the Australian HILDA Survey. *Travel Behaviour and Society*, 37, 100839. https://doi.org/10.1016/j.tbs.2024.100839

Stiles, J., & Smart, M. J. (2021). Working at home and elsewhere: daily work location, telework, and travel among United States knowledge workers. *Transportation*, 48(5), 2461-2491. https://doi.org/10.1007/s11116-020-10136-6

Sullivan, O., Gershuny, J., Sevilla, A., Foliano, F., Vega-Rapun, M., Lamote de Grignon, J., Harms, T., & Walthéry, P. (2021). Using time-use diaries to track changing behavior across successive stages of COVID-19 social restrictions. *Proceedings of the National Academy of Sciences*, 118(35), e2101724118. https://doi.org/10.1073/pnas.2101724118

Tahlyan, D., Said, M., Mahmassani, H., Stathopoulos, A., Walker, J., & Shaheen, S. (2022). For whom did telework not work during the Pandemic? understanding the factors impacting telework satisfaction in the US using a multiple indicator multiple cause (MIMIC) model. *Transportation Research Part A: Policy and Practice*, 155, 387-402. https://doi.org/10.1016/j.tra.2021.11.025

Tao, Y., Petrović, A., & van Ham, M. (2023). Working from home and subjective wellbeing during the COVID-19 pandemic: the role of pre-COVID-19 commuting distance and mode choices. *Journal of Transport Geography*, 112, 103690. https://doi.org/10.1016/j.jtrangeo.2023.103690

Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica*, 26(1), 24-36. https://doi.org/10.2307/1907382

Wöhner, F. (2022). Work flexibly, travel less? The impact of telework and flextime on mobility behavior in Switzerland. *Journal of Transport Geography*, 102, 103390. https://doi.org/10.1016/j.jtrangeo.2022.103390

Wöhner, F. (2023). Work flexibly, travel more healthily? How telework and flextime affect active travel in Switzerland. *Transportation Research Part A: Policy and Practice*, 174, 103748. https://doi.org/10.1016/j.tra.2023.103748

Wu, H., Chang, Y., & Chen, Y. (2024). Greenhouse gas emissions under work from home vs. office: An activity-based individual-level accounting model. *Applied Energy*, 353, 122167. https://doi.org/10.1016/j.apenergy.2023.122167

Zhu, P. (2012). Are telecommuting and personal travel complements or substitutes?. *The Annals of Regional Science*, 48(2), 619-639. https://doi.org/10.1007/s00168-011-0460-6

Zhu, P. (2013). Telecommuting, household commute and location choice. *Urban Studies*, 50(12), 2441-2459. https://doi.org/10.1177/0042098012474520

Zhu, P., Wang, L., Jiang, Y., & Zhou, J. (2018). Metropolitan size and the impacts of telecommuting on personal travel. *Transportation*, 45, 385-414. https://doi.org/10.1007/s11116-017-9846-3

Table 1. Summary statistics

	Mean	Std. Dev.
Panel A. Time use variables		
Total travel time	53.993	58.100
Total travel time, excluding commuting time	17.645	33.956
Personal travel time	2.738	13.600
Leisure travel time	8.276	22.583
Housework travel time	5.247	19.314
Childcare travel time	1.341	9.777
Education travel time	0.043	1.035
Panel B. Socio-demographics		
Telework	0.272	0.445
Male	0.544	0.498
Age: 18 – 29	0.242	0.429
Age: 30 – 39	0.232	0.423
Age: 40 – 49	0.233	0.423
Age: 50 – 59	0.206	0.405
Age: 60 – 69	0.076	0.265
Age: 70+	0.010	0.102
Native citizen	0.897	0.304
Education: No qualifications	0.012	0.109
Education: Basic qualifications	0.206	0.405
Education: High school	0.198	0.399
Education: Apprenticeship	0.075	0.264
Education: Undergraduate level	0.262	0.440
Education: Higher degree	0.247	0.431
Self-employed worker	0.091	0.288
Hours normally worked per week	36.727	8.687
Married or living in couple	0.771	0.420
Household size	2.863	1.235
Number of children	0.668	0.927
Family income	46,778.840	24,996.970
Observations	**758**	
Individuals	**675**	

Notes: This table presents the summary statistics of our sample, computed using survey demographic weights. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days.

Table 2. Estimates on travel time

	Total travel time	Total travel time, no commuting
Telework	-61.369***	-10.968***
	(4.593)	(3.407)
Male	11.402**	2.624
	(4.578)	(3.095)
Age: 18 – 29	13.971	12.769
	(10.972)	(9.564)
Age: 30 – 39	14.854	14.468
	(11.264)	(10.227)
Age: 40 – 49	5.931	6.436
	(10.668)	(9.187)
Age: 50 – 59	7.905	9.633
	(10.927)	(8.918)
Age: 60 – 69	13.616	17.435*
	(12.885)	(9.374)
Native citizen	1.006	-3.550
	(8.147)	(4.468)
Education: Basic qualifications	-1.266	-15.307
	(19.074)	(12.489)
Education: High school	-3.334	-17.403
	(18.998)	(12.421)
Education: Apprenticeship	-6.619	-19.335
	(20.342)	(13.200)
Education: Undergraduate level	5.945	-12.123
	(19.519)	(12.737)
Education: Higher degree	1.027	-14.178
	(19.535)	(12.838)
Self-employed worker	-6.078	10.730
	(8.777)	(7.604)
Hours normally worked per week	-0.128	-0.127
	(0.315)	(0.158)
Married or living in couple	0.064	1.764
	(5.815)	(3.870)
Household size	3.275	-2.250
	(3.205)	(2.010)
Number of children	-3.524	1.402
	(3.814)	(2.658)
Log of family income	2.419	4.370
	(5.005)	(3.005)
Constant	1.135	-17.744
	(55.260)	(33.258)
Occupation F.E.	Yes	Yes
Region F.E.	Yes	Yes
Day F.E.	Yes	Yes
Observations	758	758
Individuals	675	675
R-squared	0.252	0.074

Notes: OLS estimates. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days. Robust standard errors, clustered at the individual level, in parentheses. Dependent variables are time spent traveling, measured in minutes per day. The estimates also control for occupation, region, and day fixed effects, though these are omitted from the presentation for brevity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3. Estimates on travel purposes

	Personal time	Leisure time	Housework time	Childcare time	Education time
Telework	-4.048***	-2.308	-4.890**	0.217	0.062
	(1.133)	(2.142)	(2.197)	(1.005)	(0.105)
Male	0.401	1.067	1.424	-0.216	-0.052
	(0.993)	(2.036)	(1.983)	(0.705)	(0.084)
Age: 18 – 29	-0.377	2.015	9.237*	1.747	0.147
	(3.374)	(6.165)	(4.737)	(1.647)	(0.185)
Age: 30 – 39	0.530	2.989	7.024	3.546*	0.379
	(3.497)	(5.652)	(5.727)	(1.918)	(0.349)
Age: 40 – 49	0.735	-2.375	5.763	2.121	0.193
	(3.686)	(5.350)	(4.200)	(1.584)	(0.231)
Age: 50 – 59	1.427	3.128	3.943	0.970	0.164
	(3.231)	(5.699)	(3.825)	(1.354)	(0.196)
Age: 60 – 69	11.961**	-2.943	6.696*	1.549	0.171
	(5.345)	(5.482)	(3.841)	(1.508)	(0.198)
Native citizen	-2.023	-4.595	1.901	1.136	0.031
	(1.957)	(3.507)	(1.690)	(0.838)	(0.181)
Education: Basic qualifications	-2.615	-5.081	-7.920	0.343	-0.035
	(4.331)	(9.546)	(9.174)	(1.467)	(0.101)
Education: High school	-0.991	-7.076	-9.452	0.167	-0.050
	(4.377)	(9.512)	(9.145)	(1.136)	(0.107)
Education: Apprenticeship	-1.662	-7.171	-10.373	-0.117	-0.012
	(4.635)	(9.712)	(9.682)	(1.082)	(0.084)
Education: Undergraduate level	0.981	-2.253	-10.544	-0.286	-0.020
	(4.838)	(9.748)	(8.981)	(1.253)	(0.089)
Education: Higher degree	-0.246	-4.606	-10.508	0.931	0.251
	(4.501)	(9.969)	(9.159)	(1.172)	(0.209)
Self-employed worker	4.205	1.049	6.181	-0.771	0.065
	(2.639)	(4.052)	(5.487)	(0.746)	(0.070)
Hours normally worked per week	-0.011	-0.001	-0.017	-0.099**	-0.000
	(0.051)	(0.123)	(0.087)	(0.041)	(0.002)
Married or living in couple	1.097	0.907	-0.588	0.321	0.027
	(1.053)	(2.441)	(2.806)	(0.456)	(0.044)
Household size	0.801	-3.113***	0.319	-0.244	-0.013
	(0.777)	(1.192)	(1.565)	(0.160)	(0.024)
Number of children	-0.266	1.387	-1.146	1.473***	-0.045
	(0.787)	(1.472)	(1.993)	(0.529)	(0.039)
Log of family income	-0.907	3.635	0.907	0.592	0.142
	(1.152)	(2.264)	(1.652)	(0.520)	(0.108)
Constant	9.711	-9.670	-9.916	-5.973	-1.896
	(11.759)	(24.329)	(18.779)	(5.899)	(1.543)
Occupation F.E.	Yes	Yes	Yes	Yes	Yes
Region F.E.	Yes	Yes	Yes	Yes	Yes
Day F.E.	Yes	Yes	Yes	Yes	Yes
Observations	758	758	758	758	758
Individuals	675	675	675	675	675
R-squared	0.113	0.059	0.060	0.065	0.045

Notes: OLS estimates. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days. Robust standard errors, clustered at the individual level, in parentheses. Dependent variables are time spent traveling, measured in minutes per day. The estimates also control for occupation, region, and day fixed effects, though these are omitted from the presentation for brevity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Robustness checks: Alternative sample selection and variable transformations

	Total travel time	Total travel time, no commuting	Personal time	Leisure time	Housework time	Childcare time	Education time
Panel A. No self-employed workers							
Telework	-61.675***	-8.634**	-3.710***	-1.508	-3.469*	-0.019	0.071
	(4.779)	(3.344)	(1.127)	(2.290)	(1.968)	(1.056)	(0.120)
Observations	680	680	680	680	680	680	680
Individuals	612	612	612	612	612	612	612
R-squared	0.259	0.077	0.102	0.07	0.061	0.073	0.051
Panel B. No weekend days							
Telework	-64.265***	-12.473***	-4.004***	-3.490	-5.344**	0.296	0.070
	(4.919)	(3.623)	(1.199)	(2.233)	(2.377)	(1.105)	(0.120)
Observations	618	618	618	618	618	618	618
Individuals	618	618	618	618	618	618	618
R-squared	0.270	0.096	0.116	0.084	0.071	0.070	0.050
Panel C. Inverse hyperbolic sine transformation							
Telework	-3.292***	-0.764***	-0.340***	-0.215	-0.322**	-0.043	0.002
	(0.177)	(0.199)	(0.092)	(0.151)	(0.140)	(0.068)	(0.017)
Observations	758	758	758	758	758	758	758
Individuals	675	675	675	675	675	675	675
R-squared	0.427	0.077	0.085	0.078	0.064	0.092	0.049

Notes: OLS estimates. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days. Panel A excludes self-employed workers. Panel B omits weekend days. Panel C computes the inverse hyperbolic sine of daily time spent traveling. Robust standard errors, clustered at the individual level, in parentheses. Dependent variables are time spent traveling, measured in minutes per day. The estimates also control for socio-demographic characteristics, occupation, region, and day fixed effects, though these are omitted from the presentation for brevity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5. Robustness checks: Alternative definitions of telework

	Total travel time	Total travel time, no commuting	Personal time	Leisure time	Housework time	Childcare time	Education time
Panel A. At least 60 minutes working at home							
Telework part day	-56.080***	-5.769	-3.554***	-1.661	-1.502	0.904	0.044
	(4.931)	(3.675)	(1.138)	(2.276)	(2.633)	(0.869)	(0.089)
Observations	758	758	758	758	758	758	758
Individuals	675	675	675	675	675	675	675
R-squared	0.241	0.063	0.111	0.058	0.051	0.06	0.045
Panel B. All paid jobs outside the workplace							
Telework full day	-59.652***	-10.185***	-3.818***	-1.964	-5.347**	0.895	0.049
	(4.610)	(3.316)	(1.164)	(2.078)	(2.148)	(0.900)	(0.098)
Observations	758	758	758	758	758	758	758
Individuals	675	675	675	675	675	675	675
R-squared	0.256	0.073	0.112	0.059	0.063	0.067	0.045
Panel C. At least 60 minutes working outside the workplace							
Telework part day	-51.676***	-4.482	-3.307***	-0.630	-1.459	0.871	0.044
	(5.086)	(3.693)	(1.194)	(2.312)	(2.628)	(0.854)	(0.088)
Observations	758	758	758	758	758	758	758
Individuals	675	675	675	675	675	675	675
R-squared	0.218	0.061	0.109	0.058	0.051	0.067	0.045

Notes: OLS estimates. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days. Panel A includes a dummy variable that takes the value 1 for workers who spent at least 60 minutes working at home, and 0 otherwise. Panel B includes a dummy variable that takes the value 1 for workers who spent all time working outside the workplace, and 0 otherwise. Panel C includes a dummy variable that takes the value 1 for workers who spent at least 60 minutes working outside the workplace, and 0 otherwise. Robust standard errors, clustered at the individual level, in parentheses. Dependent variables are time spent traveling, measured in minutes per day. The estimates also control for socio-demographic characteristics, occupation, region, and day fixed effects, though these are omitted from the presentation for brevity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6. Heterogeneity analysis, by gender

	Total travel time		Total travel time, no commuting		Personal time		Leisure time		Housework time		Childcare time		Education time	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Telework	-45.424***	-73.186***	-4.741	-14.982***	-4.004***	-5.178**	-1.833	-1.156	-1.010	-8.131**	1.859	-0.446	0.247	-0.071
	(5.698)	(7.549)	(4.060)	(5.399)	(1.275)	(2.113)	(2.517)	(3.232)	(1.520)	(3.851)	(2.407)	(1.023)	(0.246)	(0.071)
Socio-demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	379	379	379	379	379	379	379	379	379	379	379	379	379	379
Individuals	339	336	339	336	339	336	339	336	339	336	339	336	339	336
R-squared	0.315	0.281	0.153	0.133	0.172	0.160	0.182	0.084	0.103	0.133	0.116	0.077	0.092	0.095

Notes: OLS estimates. Data come from the 2023 ELiDDI survey. Sample is restricted to employed individuals on working and typical days. Robust standard errors, clustered at the individual level, in parentheses. Dependent variables are time spent traveling, measured in minutes per day. The estimates also control for socio-demographic characteristics, occupation, region, and day fixed effects, though these are omitted from the presentation for brevity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Supplementary material

Table A1. Sample selection

	# individual observations	# individual-day observations
Starting with	2,179	3,784
No atypical days	1,606	2,409
Employed individuals	1,020	1,546
Working days	819	918
No missing data	**675**	**758**

Notes: This table presents the count of individual and individual-day observations following the application of each sample selection criterion. Data come from the 2023 ELiDDI survey. The final row, emphasized in bold, represents the number of observations utilized in the primary econometric analyses conducted in this study.