Post COVID-19 Trip Rate Estimation in Ireland

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As part of the update of the National Transport Authority's Regional Modelling System to a 2022 base year, new trip rates were estimated based upon twenty thousand trip diary records gathered across two days as part of the 2022 National Household Travel Survey. These are the first set of trip rates estimated in Ireland since the COVID-19 pandemic and the advent of widespread working from home and hybrid work practices, and these rates provide an important insight into emerging trends in travel behaviour in recent years. Trip rates were estimated using a negative binomial regression model for separate trip purposes, and detailed population sub-segments were designed to increase the representation of trip making in groups historical excluded from certain activities in transport models. A comparison of trip rates from the 2022 data to those estimated in 2017 was undertaken and reveals an, as expected, decline in trips to work (HBW), however this decrease is found to be completely offset by increase in Other trips (HBO) for workers, resulting in no overall change to daily trip making when viewed from a trip frequency perspective. Results also indicate a three-fold increase in non-home-based trips between the two survey years.

1 Introduction

Since the mass adoption of working from home during the COVID-19 pandemic, and subsequent retention of these practices or hybrid working practices, it is no longer reasonable to assume that travel behaviours still follow the well-established patterns observed over previous decades. As part of the update of the NTA's Regional Modelling System (RMS), an update to the trip rates used in the trip generation stage of the model (a variant on the classic four-stage transport model) was required. As part of this update, it was possible to examine any changes in trip purpose specific trip making that may have occurred since the pandemic. This paper outlines the results of both the trip rate estimation process, and comparisons with pre-pandemic trip frequency by trip purpose.

2 Literature Review

During the pandemic, there were a number of attempts by researchers and transport agencies internationally to estimate the long-term impact on trip rates of the trends in working patterns that had begun to be observed during COVID. The National Transport Authority (2020) in Ireland proposed an "alternative future demand scenario" involving reductions of between 10% and 25% in trip rates for various purposes (most notably for white-collar work trips and tertiary education trips). In the UK, Steer (2021), on behalf of the National Infrastructure Commission, investigated the impact on travel demand of five different scenarios. In those scenarios involving reduced trip rates, the reduction was between roughly 4% and 6% (depending on social group) in the case of commuting, 5% to 10% for education, up to 10% for leisure/social trips and up to 7% for business trips. Other studies carried out during COVID and attempting to quantify the scale of these impacts in a post-pandemic world included Stantec (2021, Scotland), Currie et al (2021, Victoria,

Australia), Barrero et al. (2021, United States), Kogus et al. (2022, Israel and Czechia) and Santos and Azhari (2022, England and Wales).

Positive evidence of longer-term changes has begun to emerge following the end of the COVID pandemic, particularly from travel surveys and analyses based thereon. For example, in the UK, an analysis of National Travel Survey data by Transport Modelling Ltd (2024) found a 17.1% decline in commuting trip rates, 42% in business trip rates and 17.5% in shopping and personal business trip rates between 2015 and 2022; meanwhile, education and escort trip rates increased by 2.5% and leisure trip rates by 8.9%, leading to an overall 7.7% decline in trip rates (ibid., Table 1). The Scottish Household Survey (Transport Scotland 2024) and the London Travel Demand Survey (Transport for London 2024) also reported noticeable reductions in commuting and shopping trip rates.

Similar patterns have been observed in the United States. The National Household Travel Survey (Federal Highway Administration 2024, Table 4-5) found that daily work trips per person fell from 0.59 to 0.42 (-28.8%) between 2017 and 2022. Meanwhile, "shopping and errands" trips decreased from 1.30 to 0.80 (-38.5%), school and church trips from 0.37 to 0.26 (-29.7%), social and recreational trips from 0.93 to 0.67 (-28.0%) and other trips from 0.19 to 0.13 (-31.6 %). Overall trip rates fell from 3.37 to 2.28 (-32.3%).

3 Data

The updated trip rates were estimated using observations from the NTA's 2022 National Household Travel Survey (NHTS). The NHTS is a two-part survey comprised of a household survey and accompanying trip diary completed by each member of the household over 4 years of age. The diary records were filtered to exclude diary days with incomplete records, individuals with missing socio-economic data, and trips undertaken on Saturdays and Sundays (as the NTA's models specifically model to weekday travel). Once these records were removed, 14,216 records (diary days) were available for the estimation of the six models (one for each of the trip purposes). Note, diary days are not the same as trips, the number of trips occurring for a given purpose during a diary day is the independent count variable.

4 Methods

The trip rates are estimated using a negative binomial regression as this is the more suitable model for count data that is over-dispersed than Poisson models. Estimation was undertaken for six distinct trip purposes, namely:

- Home Based Work/Commute (HBW)
- Home Based Education (HBEd)
- Home Based Other (HBO)
- Home Based Food Shopping (HBFS)
- Home Based Visiting (HBV)
- Home Based Employer's Business (HBEB)

The dependent variables were the number of from-home trips made for a given purpose each day, and the independent variables were Age (in bands), Male/Female, Blue/White Collar, Economic Status, NTA Area Type, Household Car Ownership, and the Diary Day on which the trip occurred (to account for response fatigue).

The relationship between the dependent and the independent variables is described by:

$$y = e^{(B_{i*} + C)}$$

Where:
Y = trip rate
Bi = estimated parameter for variable B level i
C = constant term

An update was also made to model exclusions rules, with individuals being allowed to make trips for reasons beyond their primary economic status, for example workers or retired people are now able to make education trips, while students can travel to work. Survey data also indicates that some counter-intuitive trips also occur, such retired people making work trips, however these are included as the survey only assess their primary economic status, and someone who considers themselves retired may still be undertaking some form of part-time or occasional employment without altering their primary status.

5 Results

Table 1 presents total number of trips by purpose and the whole-sample trip rate for each purpose. Results demonstrate that the most common trip purpose is "Other" (HBO), although this somewhat of a catch-all category, followed by Commuting (HBW) and Education (HBEd). These values provide an overview of the relative magnitudes of trip making by purpose for a typical weekday across the Irish population.

Table 1: Whole Sample Trip Rates

Variable	Total Trips	Mean Rate	Min. Rate	Max. Rate	Std. Dev.
HBW	3,936	0.278	0	4	0.483
HBEd	2,608	0.185	0	4	0.398
HBO	6,850	0.485	0	6	0.747
HBFS	1,173	0.083	0	3	0.287
HBV	755	0.054	0	5	0.237
HBEB	390	0.028	0	5	0.193

5.1 Comparisons with 2016

A comparison with data from 2016 was carried out for a subset of respondents. A whole sample comparison was not carried out as rules regarding exclusions for trip purposes had changed during the model rebasing so comparisons would not be valid. Comparing individuals engaged in full time or part time employment was preferred as it allows a more meaningful comparison between the two modelled years. Results indicate that, while trips to work have decreased notably between the two years, overall trip making is actually relatively stable, with an increase in Other trips balancing the reduction in commuting trips attributed to changing working patterns.

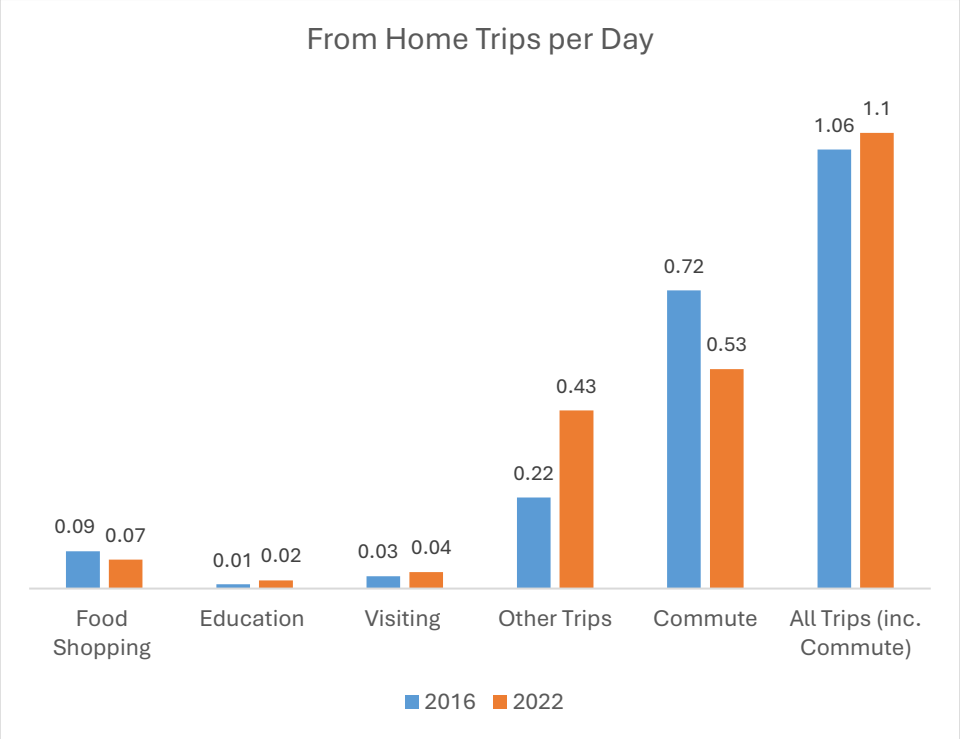

Figure 1: 2016 vs 2022 Trip Making for Workers

5.2 Validations

To allow an understanding of the model fit, 30% of the diary records for the 2022 data were held back for the purposes of validation. To allow a meaningful comparison given the discrete and blocky nature of the count data in the observations, validation plots are prepared for sub-grouping within the data (such as 20–44-year-old females from small towns) rather than individuals. Results are then presented in terms of trip rates and trip totals for the observed and modelled. Figures 2 and 3 present the results for the commuting trips, showing a strong level of agreement for both trip rates and trip totals between modelled and observed. Figures 4 and 5 show the same comparisons for the smaller food shopping segment, and highlights the issues with smaller segments, specifically where more zeros are present within the observed data. The trend was repeated throughout the estimation, with commuting, other, and education trips (which account for ~ 85% of the observations when combined) all showing very high levels of agreement between modelled and observed, leading to a high level of confidence that the models do a good job replicating the patterns observed within the NHTS.

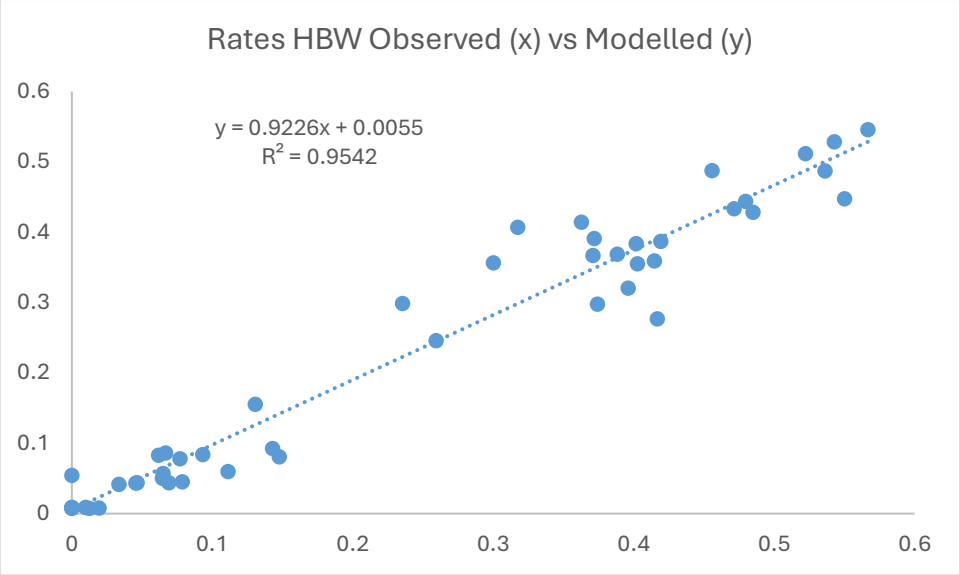

Figure 2: Commuter Rates Validation

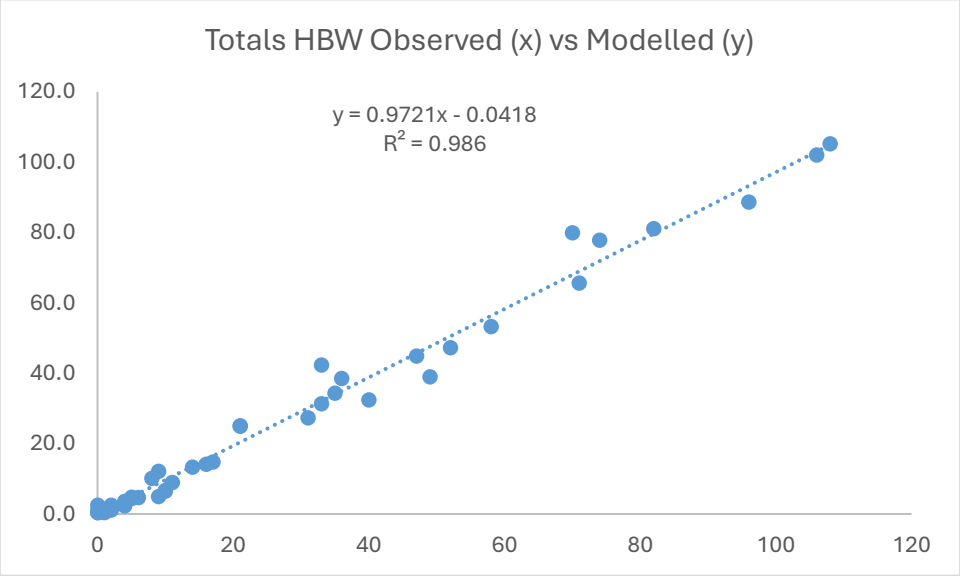

Figure 3: Commuter Totals Validation

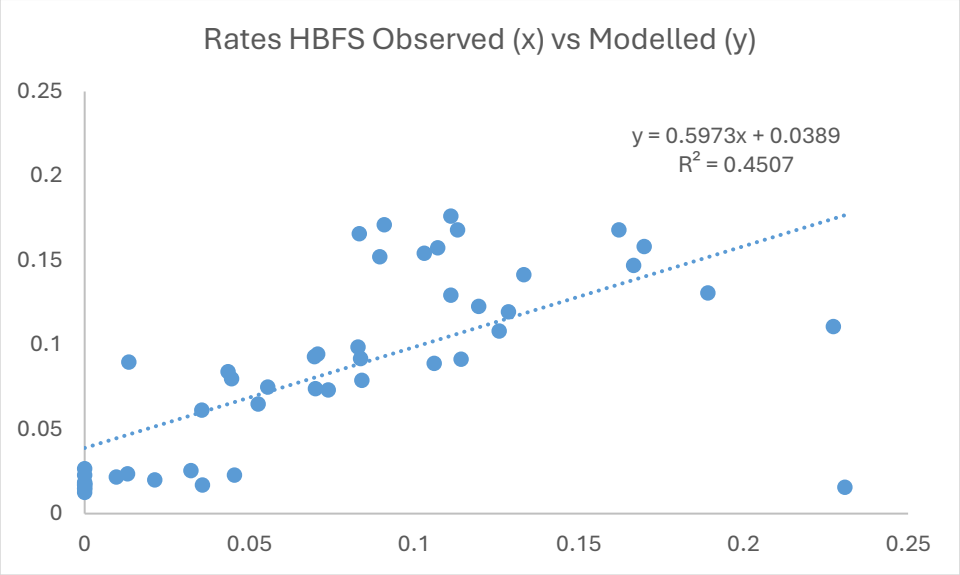

Figure 4: Food Shopping Rates Validation

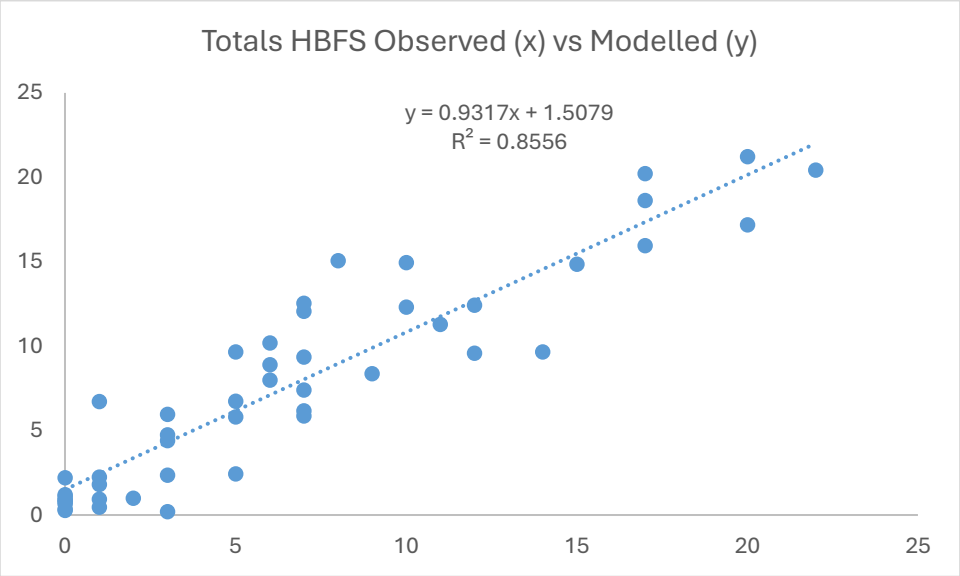

Figure 5: Food Shopping Totals Validation

6 Summary and Conclusions

Due to the observed changes in travel behaviour post the COVID-19 pandemic, and in line with requirements to rebase the NTA's modelling suite, new trip rates were estimated for Ireland based on 2022 travel survey data. Results of the negative binomial estimations indicate that trip making for the purposes of commuting to work (HBW) has declined considerably with respect to 2016 estimations, however overall levels of trip making have remained stable, with increased levels of trip making for other (HBO) reasons offsetting the decreases in commuting trips. Trip rates were also updated to include trips made for purposes beyond the respondents' primary economic statues, for example allowing students to make trips to work, to reflect the complex nature of trip making, and that individuals may hold more than one economic status.

The datasets were split into estimation and hold-out samples. Comprising 70% and 30% of the samples respectively for the purposes of validation. The results of this validation process show strong levels of agreement for the large travel purpose segments, providing modellers with a high

level of confidence that the models are replicating the patterns seen in the data. It should be noted that any errors or biases within the survey itself will still be present as independent data was not available for further comparison, however sense checks with previous estimations and international experience provide confidence that the results are sensible.

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