ERASMUS UNIVERSITY ROTTERDAM

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Bachelor Thesis - Economics and Business Economics

Shared Micro-mobility – Transport Only for the Wealthy?

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Abstract

This paper analyzed whether income influences the usage of shared micro-mobility (shared e-scooters, standing e-scooters, e-bikes, and bikes) among students from different countries. Shared micro-mobility modes have been introduced as a new form of sustainable transportation in many cities across the world over the past years. Despite their potential for reducing CO_2 emissions from transportation, the modes are promising for reducing travel times in congested city centers and improving the accessibility of places that are badly connected to the transport network. Not having adequate access to transportation, either financially or due to the underprovision of transport infrastructure, poses students at risk of social, educational, and professional exclusion. By means of logistic regressions, this study found that having a higher income increases the predicted probability of someone being a shared micro-mobility user; however, this relation was only evident among observations of disposable income below 2000€ per month. The study also found that high prices and unavailability of the vehicles in some respondents' neighbourhoods were discouraging reasons for using shared micro-mobility. Recommendations for policymakers regarding creating better access to shared micro-mobility for lower-income individuals are presented.

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1. Introduction

An average Dutch person spends 12,9% of their household income on transportation (CBS, 2015). Lower-income people, however, tend to spend up to 21% of their income on being mobile (Venter, 2011). For many people, spending on transport is therefore the second largest source of spending after housing and its related utility costs, embodying a clear financial burden for some. Even though many governments are consistently trying to make transportation more affordable and equitable, public transport fees seem to steadily rise and many areas have not seen improvements in their accessibility over the past years. Recently, however, a new mode of transport has seen its inauguration. In many cities across the world, a surge in shared e-scooters, bikes, and e-bikes, solidified under the term "shared micro-mobility", is creating a new reality for urban transportation. So far, the new transportation modes have particularly been promoted to cannibalize private car use and thereby reduce CO_2 emissions as well as traffic congestion in urban centers.

However, a social equality problem shared micro-mobility has the potential to solve is creating better accessibility to professional and private activities for people living in poorly connected areas, so-called "transit deserts" (Zarif et al., 2019). People in these areas, although dependent on (public) transportation for their everyday activities such as commuting to work, lack sufficient transit services in their area and often have longer travel times despite covering shorter distances (Cui et al., 2019).

Since ("dock-less", i.e., free-floating) shared micro-mobility allows a user to travel to anywhere within the provider's service area, without the need to purchase an own vehicle, the different modes can achieve better connectivity for people living in places with insufficient or lacking transport networks. Moreover, the vehicles usually achieve faster travel within urban areas while simultaneously being a more sustainable transport mode compared to cars.

Up to date, students are among the main users of shared micro-mobility (Reck & Axhausen, 2021). Their specific transport needs range from traveling to university to taking trips to their family, friends, and leisure activities. Having access to both professional and social opportunities is a cornerstone for young adults' well-being and their future economic opportunities, whereby affordable and available transportation is crucial for capturing these benefits.

Considering the potential of shared micro-mobility for improving accessibility to professional, educational, and social occasions, this research aims to detect whether students with fewer disposable income suffer from transport disadvantages in using shared micro-mobility. More specifically, the objective is to examine whether poorer individuals are less likely to use shared micro-mobility, even though they would like to if their financial means or the availability of shared micro-mobility in their home area would allow them to. This research will thus explore the following research question:

Does income have an influence on shared micro-mobility usage among young adults?

Next to determining whether a correlation between income and shared micro-mobility usage exists, the research will also dive into the underlying reasons for the non-usage of the shared modes. By doing so, we hope to get a picture of whether costs or lacking availability of shared micro-mobility in certain areas pose a usage barrier to students with lower incomes. The aim of the research is thus to detect whether income is a significant determinant of whether someone takes advantage of shared micro-mobility services.

Considering the broad scope of the research question, the analysis was divided into two parts framed by two sub-questions of the research. We first evaluate the direct relation between income and shared micro-mobility usage through studying the following sub-question:

(1) *Does higher income increase the probability of a young adult being a shared micro-mobility user?*

Since the question above does not differentiate between daily, weekly or occasional users, we additionally investigate the association between income and frequency of usage among young adults. The following sub-question encompasses this analysis:

(2) *Does higher income lead to more frequent usage of shared micro-mobility usage among young adults?*

As mentioned by Liao and Correia (2020), scientific research on the influences of shared micro-mobility on social equality has not been conducted to a large extent. So far, research has primarily focused on the environmental, safety, and improved transportation (e.g., reduced congestion) impacts of augmented shared micro-mobility modes, while its impact on social equality lacks extensive research. Moreover, university students are an understudied target group regarding prevailing inequalities in transport, while research on shared micro-mobility in the Netherlands is also insufficient to date and allows investigating whether country-specific factors such as a strong cycling culture influence the adoption of shared micro-mobility.

This research can contribute to effective policy making aimed at decreasing inequalities in access to transportation – inequalities that can create transport disadvantages, potentially leading to exclusion from social or professional opportunities for lower-income individuals. Micro-mobility has notably big potential among students and young professionals, a group known to be tech-savvy and open to trying out new innovations, and therefore also among the early adopters of shared micro-mobility over the past years (Reck & Axhausen, 2021; Zijlstra et al., n.d.; Azimi,2021). Eccarius and Lu (2020) discuss that governments have specific objectives to promote sustainable transportation among this target group

due to the hope for responsible and environmentally friendly transport behavior among young people to become a long-term habit, eventually to be transferred to their descendants. Hence, the focus of this research on transport inequalities among university students gives insights into the social equality side of shared micro-mobility, which should be considered in policy making around sustainable transportation.

First, this paper will analyze existing literature on how transport inequalities can affect underprivileged groups of society, followed by discussing the potential of shared micro-mobility in weakening some of these disadvantages. Chapter 2 will also review prior research on reasons for adopting shared micro-mobility as well as people's concerns about the modes. Chapter 3 will present the methodology of the research. To gather data, a survey asking questions about shared micro-mobility usage patterns and someone's disposable income was spread among students from different educational backgrounds and countries. The data was then analyzed by means of a logistic regression of disposable income on whether someone is a micro-mobility user, once including all observations and once for disposable incomes below 2000€ per month; the results of these regressions are presented in chapter 4. The underlying reasons for non-users to restrain from using shared micro-mobility and their personal views on the advantages are moreover analyzed. In chapter 5, the results are discussed and conclusions regarding the research question are drawn, followed by presenting recommendations for policymakers regarding the establishment of equitable shared micro-mobility provision. The last chapter outlines the limitations of the research and provides suggestions for future research.

2. Theoretical Framework

2.1 The effects of transport disadvantage

Good education is a prerequisite for finding a job that ensures financial stability in today's world. More and more young adults attend university every year, thereby laying the groundwork for finding work that ensures one earns enough income for living a carefree life. Even though the number of young adults who stem from low-income households and attend university has significantly risen over the past years (Pew Research Center, 2019), disproportionalities remain. Clearly, many different factors influence why students from low-income households are less likely to attend university, among others high tuition fees in many countries, possible relocation costs, or lower provision of secondary education in less wealthy neighborhoods. Research has found that transport availability and transport costs also create a burden for low-income individuals to access higher education (Hine, 2016). Low-income students are more likely to still live with their parents or in a city's cheaper areas to save on housing costs, thereby often living at farther distances from universities or the city center where most of a student's educational and social life takes place.

Apart from attending university, low-income students are less likely to engage in the same social activities, or engage in social activities with the same frequency, compared to financially better off individuals (Cao et al., 2019). Often, transport costs and availability once again play a role, as e.g., high public transport fares or restricted public transport times in certain areas could impede less well-off individuals to take a trip to e.g., meet up with their friends.

Thus, transportation costs and transport accessibility significantly influence individuals' travel decisions and thereby their engagement in professional, social and leisure activities. Previous research has found that not having a car is also correlated with lower realised travel (Delbosc & Currie, 2011), indicating that alternative transport modes do not achieve similar accessibility and mobility as car transport does.

Whether a student is impacted by inequalities in transport accessibility can be described by a triangle between housing, education (and the financing of education), and transport (Guzman et al., 2017). For individuals to not suffer from transport disadvantage, i.e., for them to be able to access transport physically and financially, and hence be mobile, the distance between one's residence and educational facility needs to be reasonable far, transport possibilities need to be present and reasonably priced, and one needs to have enough financial capital to pay for the required transport. Being transport disadvantaged thus does not automatically imply that the person is at risk of social exclusion.

To reduce students' financial burden of transportation, WO, HBO and MBO students in the Netherlands are eligible to receive a public transport ticket (OV-chipkaart) for free usage either during the week or during the weekend (Studentenreisproduct.nl, n.d.). Being in possession of the OV-chipkaart might impact a student's decision of using shared micro-mobility, as using public transport instead will not occur any costs; however, even students in possession of an OV-chipkaart can still suffer from transport accessibility disadvantages if they live in areas badly connected to the transport system or alternative modes achieve more efficient transportation than public transport. It might also be the case that students who are eligible for free public transport are more wiling to spend money on shared micro-mobility since they are saving on transport costs in the first place.

2.2 The potential of shared micro-mobility

Shared micro-mobility is a new mode of transport that has gained popularity over the past years. The most prominent shared modes are moped-like e-scooters, standing e-scooters (also called kick-scooters), e-bikes and bikes. These vehicles can either be docked, whereby they need to be unlocked and dropped off at a certain docking station belonging to the respective vehicle operator, or dock-less/free-floating, whereby pick-up and drop-off is possible anywhere within the service area of the

specific provider. This research will only consider dock-less vehicles due to their increased convenience as well as their potential for reaching areas that are lacking sufficient transport connections.

Despite positive environmental benefits, primary research on shared micro-mobility has pointed out its potential for making cities more accessible for everyone, as well as its cost-saving potential for poorer individuals who lack the money for owning a car (Eccarius & Lu, 2020). Moreover, the dock-less nature of the modes enables travel to remote or generally inaccessible destinations and eliminates the last-mile travel from a parking lot (for travel by private vehicle) or a bus, train, or tram station (Liao & Correia, 2020).

The instances in which shared micro-mobility is used vary by demographic and socio-economic group, but among the most advocated purposes are business-to-business trips, last-mile solutions and recreational activities such as traveling to bars and restaurants (Espinoza et al., 2019). The US National Association of City Transportation Officials (NACTO) (2020) reports that e-bikes most prominently serve as a commuting mode, while e-scooters are equally used for commuting and recreational activities. Different research found that e-scooters are widely used for running errands or traveling across university campuses (Liu et al., 2019).

In general, transport journeys can be classified into two categories: mandatory and voluntary trips. Mandatory trips include trips which individuals are required to undertake to make a living or earn an educational degree (i.e., "commuting" trips), while also including trips to buy food, pick up one's children from school or go to the doctor. Voluntary trips, on the other hand, contain trips to recreational facilities, meetings with social contacts, or any other places which do not need to be visited for basic survival. Lucas et al. (2016) found that voluntary trips most strongly rise as income rises, possibly due to longer travel times for mandatory trips (as low-income individuals have less freedom in choosing their residential location), depriving them of time to embark on voluntary social trips.

Research on Chicago's urban area has shown that e-scooters can increase job accessibility within the city by 16% for commuting distances up to 30 minutes (Smith & Schwieterman, 2018). Thus, the vehicles could allow people residing in districts of urban areas that are poorly connected to the transport system to access jobs better, increasing these individuals' work opportunities and/or lowering their commuting time without public investment in transport infrastructure. Similarly, improved accessibility to social opportunities would go hand in hand. With the on-going Covid-19 crisis, cities such as the municipality of Rotterdam have also started promoting shared micro-mobility for reasons of facilitating social distancing and relieving public transport of large passenger crowds (RET, n.d.). Since increased consciousness about hygiene is likely to remain even after the pandemic ends,

paired with municipalities putting a focus on replacing car travel by more environmentally friendly transport, the micro-mobility market is expected to keep growing in the coming years (Heineke et al., 2020).

In the US, some initiatives have already been launched to lower barriers to access for minority or low-income groups. These initiatives are intended at increasing shared micro-mobility usage of underprivileged people through increasing the availability of vehicles in "communities of concern" as well as offering price discounts and implementing marketing efforts aimed at these specific communities (NACTO, 2020). For example, Divvy Bikes in Chicago launched its Divvy for Everyone (D4E) initiative in cooperation with the Chicago Department of Transportation (CDOT). The program offers individuals aged 16+ who have an annual income at or below the 300% Federal Poverty Level the opportunity to purchase a first-year annual membership for the shared bike system at a cost of $5 (Divvy Bikes, n.d.). Purchasing the plan can also be done by cash payment, allowing individuals without a debit or credit card to also benefit from the offer. Such initiatives showcase public organizations' faith in shared micro-mobility as a transportation mode that could remove transport disadvantages and improve transport connectiveness for low-income groups.

2.3 Users' reasons for adopting shared micro-mobility

Research on the exact reasons why individuals choose to travel by shared micro-mobility is scarce, and the perceived advantages differ greatly per person. Despite it being an environmentally friendly alternative to cars, a main determinant of using shared micro-mobility lies in its time saving potential (Liao & Correia, 2020). Especially within urban centers, public transport tends to be crowded and delays are frequent, whereas using shared micro-mobility allows traveling on less occupied bike lanes and roads. Users thus benefit from higher time-reliability as well as more "personal space" compared to using public transport.

Moreover, research has found that particularly women would like to benefit from more flexibility regarding their transport behavior, as women often have more complex schedules and could thus decrease their travel times and benefit from more autonomy when using shared micro-mobility (ITF, 2018). The ability to pick up and drop off the vehicle anywhere moreover upgrades the accessibility of (remote) places. Other users might simply enjoy shared micro-mobility modes as a "fun way to get around".

Comparing the prices of shared micro-mobility to costs related to the usage of a car, a cost advantage favoring micro-mobility prevails for shorter trips (Eccarius and Lu, 2020). The general prices remain high, however, especially when compared to public transport. The following example will illustrate this.

A trip by public transport from the metro stop "Maashaven" in Rotterdam South to the Erasmus University Rotterdam in Rotterdam East takes 28 minutes at a standard cost of 1,94€ (9292, n.d.). The traveler needs to first take the subway, then change once to take a tram to the destination. Taking the same route for travel by shared e-scooter from the provider *Felyx*, one would drive at a cost of 0,30€/minute (Felyx, n.d.). The distance amounts to 6km (Google, n.d.), thus assuming one travels at the legal speed of 25km/h, this trip would take 14,4 minutes and cost 4,32€. Taking an e-bike from the provider *Lime* would incur a fee of 1€ to start and 0,20€/min (Lime, 2021). Assuming someone again travels at a speed of 25km/h, this trip would cost 3,88€. Illustrated by this example, we can see that traveling by shared e-scooter or e-bike is approximately twice as fast as traveling by public transport (under ideal conditions), at the same time however also 2-2,2 times as expensive. Figure 1 plots the cost and time comparisons per different modes. The arrows in the graph compare a trip by shared e-bike, the more cost-time efficient shared micro-mobility mode, with a trip by regular bike, its most cost-time efficient competitor. While taking a shared e-bike is approximately 7,6 minutes faster, the costs when using provider *Lime* are 3,88€ higher. However, the costs for biking and car usage do not consider the initial investment of buying the vehicle or (car) insurance, which clearly make up a large part of these modes' costs. None of the times moreover account for possible delays due to traffic.

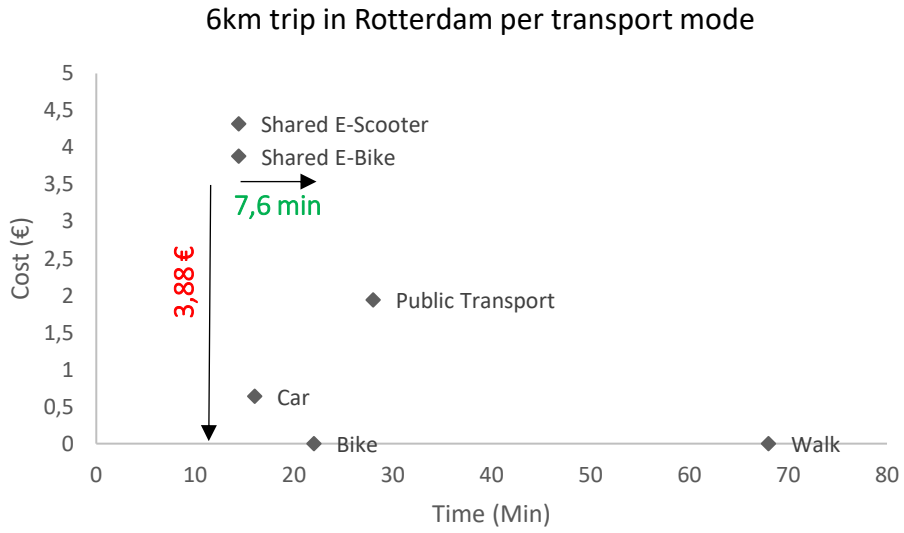


Figure 1: Graph of cost and time for a 6km trip from station "Maashaven" in Rotterdam-South to Erasmus University Rotterdam per transport mode. *Notes:* The graph plots time (in minutes) on the x-axis and the trip costs (in euros) on the y-axis. Costs and time for shared e-scooters, shared e-bikes and public transport were computed as outlined in section 2.3. Biking and car time was taken from Google Maps (n.d.). Costs by car were computed for a Volkswagen Golf MPG (i.e., a standard-sized car) by multiplying the trip distance by the fuel consumption per km (in liter) and cost per liter on 21 June 2021 in the Netherlands. Costs for car and bike usage do not consider initial investments and additional maintenance and insurance costs, thus actual costs for these modes are higher.

2.4 Concerns regarding shared micro-mobility

Shared micro-mobility usage among males has been found to be higher than usage among females (Reck & Axhausen. 2021). A factor holding back women from adopting the modes are safety concerns related to increased exposure to traffic in cities (Bieliński & Ważna, 2020). Among others, further factors found as discouraging usage include private ownership of other modes, usage complications, high prices, unavailability in certain areas or too few vacant vehicles (Bieliński & Ważna, 2020).

Further research has also indicated that shared e-scooter usage is particularly replacing walking, private and public transport usage (Nikiforiadis et al., 2021). While limiting travel by private vehicle is clearly an objective of expanding shared micro-mobility usage, the crowding-out of other (often even more) sustainable transportation modes such as walking and public transport could restore environmental concerns.

3. Methodology

To evaluate inequalities in access to shared micro-mobility, data was gathered by means of a survey spread among students and young adults from different countries. The survey asked participants to answer questions related to their (non-) usage of four different micro-mobility modes, namely e-scooters, standing e-scooters, bikes, and e-bikes. The survey mainly gathered quantitative data for the purpose of performing a corresponding average marginal effects logistic regression to analyze the correlation between the respondents' monthly allowance and their likeliness to use and frequency of using shared micro-mobility. The qualitative data will be analyzed by looking at aggregate frequencies of having chosen a certain answer to a question.

The survey follows two logics, depending on whether the respondent has or has not used shared micro-mobility in the last two years. If the respondent has not, the survey includes questions aimed at finding the underlying reasons for the non-adoption of shared modes. Finding that non-adopters do not use shared micro-mobility because the modes are not accessible in their neighborhood, or because of affordability reasons, would acknowledge equity concerns regarding the modes (Shaheen & Cohen, 2019). Moreover, by asking about personal views on shared micro-mobility's advantages and which modes the respondent would be most likely to try out, improvement recommendations for shared micro-mobility can be drawn (e.g., lowering prices to reach financially disadvantaged people). If a respondent indicates having been a user of shared micro-mobility over the past two years, a different logic is applied. For each mode that has been used, respondents are asked to indicate the frequency of personal use. This allows investigating whether the modes are being used as a primary transport mode or only for occasional trips. Subsequently, the respondents are asked about their opinion on the main advantage of the specific shared micro-mobility mode(s) they indicated using.

Both users and non-users of shared micro-mobility are then asked to indicate which vehicles they own. The question is aimed at finding out which modes are the main competitors of shared micro-mobility and whether differences in vehicle ownership among users and non-users exist. To examine possible correlations between income and the adoption of shared micro-mobility, the respondents are requested to fill in their monthly disposable income including rent. Since the survey is aimed at students, the sources of personal disposable income differ greatly. Some students are fully financed by their parents, while others might have a side job, loan, scholarship or finance themselves through mixed income sources. In this study, disposable income includes rent due to housing expenses being most students' largest expense per month (CBS, 2015). Having gathered data on the individuals' financial situations allows performing a logistic regression of monthly disposable income on (1) whether a respondent has used shared micro-mobility in the last two years and (2) the frequency of having used it. The first regression will be a logistic regression showing average marginal effects (AME), while the relation between disposable income and frequency of usage will be evaluated by means of an ordered logistic regression. In the regressions, other determining factors such as age, gender and educational background will be included, allowing us to investigate different influences on whether someone uses shared micro-mobility.

Lastly, the respondents were asked to provide personal demographic information on their age, gender, location, education, and physical impairments. This information can be used to cluster the respondents into groups with similar characteristics, thereby providing the opportunity to apply the sample to a larger population. Asking about physical impairments allows avoiding biases for non-usage of shared micro-mobility due to "practical" factors that complicate the usage of these modes.

The survey was spread among students as these make up a large share of the early adopters of shared micro-mobility, particularly in adopting shared e-scooters (Reck & Axhausen, 2021). A focus lies on students studying in Rotterdam where the network of shared micro-mobility is extensive and has seen vast adoption over the past years. A time frame of two years was used to circumvent changes in transport patterns that occurred due to the covid-19 pandemic and its related (temporary) closing of a multitude of facilities such as universities, restaurants and bars, clothing stores and sports centres. Despite the long time frame, the study is likely to still suffer from biases such as the peak-end rule, i.e. people remembering more recent activities more vibrantly than less recent ones (The Decision Lab, n.d.), suggesting that people are likely to underestimate the frequency with which they have used shared micro-mobility before the pandemic (if, as assumed, people engaged in less frequent travel during the pandemic).

4. Results

4.1 Data on shared micro-mobility usage

The data stems from the researcher's "Thesis Survey – Shared Micro-mobility" that was spread among students on 8 June 2021 via various social channels such as LinkedIn and WhatsApp. Students and young adults from different countries reacted to the survey. The complete list of the survey questions can be found in section 8.2 of the appendix. The total number of respondents amounted to 154 completed surveys; however, due to missing answers to various questions, 3 respondents' answers were not included in the analysis. Separated by specific micro-mobility mode, 57 respondents had used shared e-scooters before, 48 shared bikes, 32 shared standing e-scooters, and 15 shared e-bikes. In the Netherlands, shared standing e-scooters are not available, while (moped-like) shared e-scooters are also not available in every country. Table 1 presents summary statistics of the main variables used in the regression analysis.

Table 1: Descriptive statistics

Variable	Mean	Standard Deviation	Observations
Age	22.417	4.118	151
Gender	0.543	0.500	151
Disposable income [€]	1100.067	546.414	149
Micromobility user	0.669	0.472	151
Shared e-scooter user	0.377	0.486	151
Shared standing e-scooter user	0.212	0.410	151
Shared e-bike user	0.099	0.300	151
Shared bike user	0.318	0.467	151
Vehicle ownership			
Bike	0.768	0.423	151
Car	0.278	0.450	151
Motorcycle	0.053	0.225	151
E-bike	0.020	0.140	151
(E-)Scooter	0.020	0.140	151
OV-chipkaart free travel	0.437	0.498	151

Student	0.921	0.271	151
Education			
University (WO) - Bachelor	0.572	0.497	138
University (WO) - Master	0.246	0.432	138
Hogeschool (HBO) - Bachelor	0.058	0.235	138
Foreign country - Bachelor	0.094	0.293	138
Foreign country – Master	0.022	0.146	138
Location			
Rotterdam	0.497	0.502	151
Other part of Netherlands	0.166	0.373	151
Outside the Netherlands	0.338	0.475	151

Notes: The variable *Age* is indicated in years, *Gender* takes on 1 for female and 0 for male, and *Disposable income* is shown in euros. All variables except for *Age* and *Disposable income* show the proportion of survey respondents that belongs to the respective group.

The variable *Age* is measured in years and *Disposable income* in euros, indicating the money that someone has available for rent, tuition fees, food, leisure activities etc. per month. All other variables in Table 1 show proportions, i.e., they show the percentage of survey respondents that belong to the dummy category "1" for each specific variable. *Gender* is 1 for female, 0 for male. *Micro-mobility user* and its subcategories are 1 when someone has used one or multiple of the shared modes before, 0 otherwise. The *Vehicle ownership* categorical variables take on value 1 when someone owns the specific vehicle, 0 when the respondent does not. Student takes on value 1 when someone studies and OV-chipkaart free travel takes on value 1 when the (Dutch) respondent can use public transport for free on weekends or weekdays, 0 otherwise, respectively. For the *Education* dummies, the specific variable takes on 1 when the respondent is working towards (or has recently graduated) from the respective higher education level. For the *Location* dummies, the variable where the respondent is currently residing takes on value 1, 0 otherwise.

As shown in Table 1, 66,9% of the survey respondents have used at least one of the shared micro-mobility modes before, whereby the most used modes are shared e-scooters followed by shared bikes. The majority of survey respondents owns a bike and currently has a student status, with more than half working towards or having recently finished their bachelor's degree. Almost half the survey respondents (49,7%) are moreover located in the municipality of Rotterdam.

Since most survey respondents live in Rotterdam, we also looked at the (disposable) income distribution per district in Rotterdam. Figure 2 shows the average income per Rotterdam district based on whether someone has been using any of the micro-mobility modes in the past two years. None of the respondents living in Feijenoord or Ijsselmonde have been using shared micro-mobility, despite the district's respondents' above average income. All respondents from Nieuw Mathenesse, Noord and Rotterdam-Noord-West have used shared micro-mobility before, despite their below average income. For districts with users and non-users, no clear trend between income and usage can be determined. Figure 2 thus seems to indicate no clear relation between the two variables. The descriptive statistics do not account for students living in student housing or other subsidized apartments, which might have cheap rents despite being located in generally more affluent neighbourhoods. The figure below is thus unlikely to reflect the real relationship between disposable income and whether someone lives in a poorer or wealthier neighbourhood perfectly.

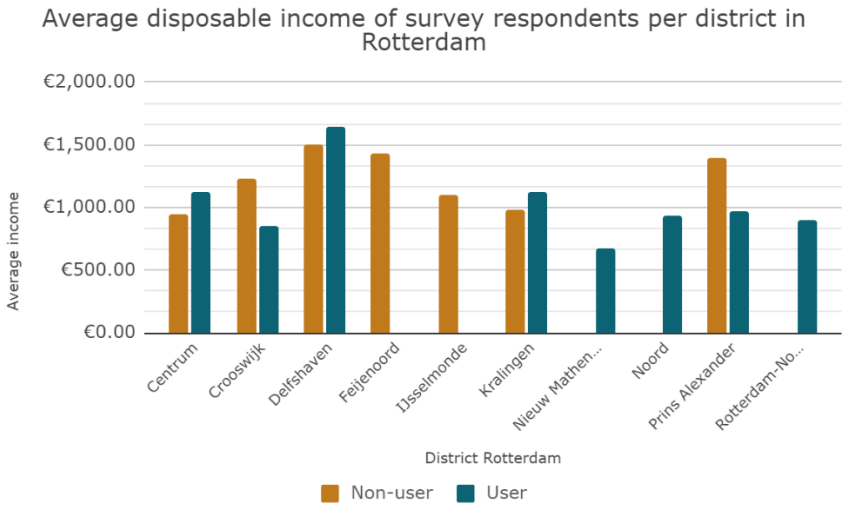


Figure 2: Average disposable income of survey respondents living in Rotterdam, categorized by district and usage pattern. *Notes:* Only districts of Rotterdam where at least one survey respondent indicated their disposable income are shown in the figure.

4.2 Regression analyses of income effects

4.2.1 Logit model for all observations

To research any correlation between disposable income and someone being a micro-mobility user, an average marginal effects (AME) logistic regression was performed. The logit model was chosen due to the binary nature of the dependent variable *Micro-mobility user.* AME estimate the regression coefficients as predicted probabilities instead of log odds, making their interpretation more straightforward.

The subsequent regressions are used to investigate the following sub-question of the research:

Does higher income increase the probability of a young adult being a shared micro-mobility user?

Figure 3 plots the relationship between disposable income and the respondents' shared micro-mobility usage patterns, i.e., whether someone has (not) used any of the modes in the past two years. Disposable income is shown in logarithms to account for skewness of the sample distribution. The fitted values seem to indicate a positive relation between the two variables; however, as the dependent variable is of binary nature, we do not have a linear relationship as shown in the graph where predictions could take on any value. Instead, we need to use a logistic model that manages to keep predictions within the [0,1] interval.

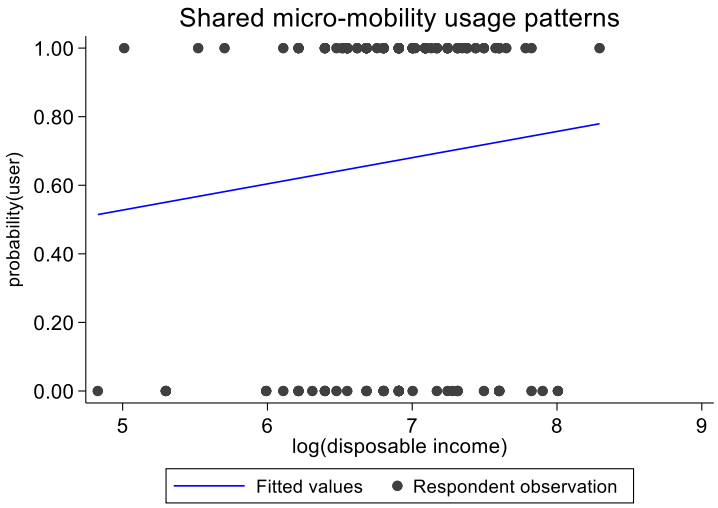


Figure 3: Plotted observations of shared micro-mobility users per logarithm of disposable income. *Notes*: An observation of 1 indicates that the respondent has used at least one of the shared micro-mobility modes before, while 0 indicates that the respondent has not used any of the modes before. Log(disposable income) is shown in euros.

To answer the preceding sub-question, a logistic regression of disposable income on the likelihood of someone being a micro-mobility user was performed. The basic model without control variables, as used in column (1) of Table 2, is the following:

$$Ln(odds) = ln\left[\frac{1}{1+e^{-(ß_0+ß_1*\log(disposable\ income))}}\left(1-\frac{1}{1+e^{-(ß_0+ß_1*\log(disposable\ income))}}\right)^{-1}\right] = ß_0 + ß_1 * \log(disposable\ income)$$

Table 2 below shows the regression results for the basic model as well as its extension by several control variables.

Table 2: Regression results for all observations – Part 1

	Micro-mobility user Logit AME (1)	Micro-mobility user Logit AME (2)	Micro-mobility user Logit AME (4)
Log (disposable income)	0.055	0.067	0.042
	(0.076)	(0.071)	(0.065)
Gender		-0.159**	-0.128*
		(0.076)	(0.078)
Age		-0.028**	-0.021*
		(0.012)	(0.011)
Student		0.082	
		(0.137)	
Location			
Outside the Netherlands			-0.171
			(0.109)
Rotterdam			0.020
			(0.101)
Number of observations	149	149	149
Prob > chi2	0.4717	0.1005	0.0234

Notes: The (binary) dependent variable is measured as a proportion in all three columns. The results are reported as average marginal effects (AME). The statistics shown are mean numbers. In parentheses, standard errors are reported. The reference category for the categorical variable *Location* is "Netherlands (excluding Rotterdam)". Variables are coded as described in section 4.1.

*** Significance at the 1% level

** Significance at the 5% level

* Significance at the 10% level

None of the models tested in Table 2 shows significant coefficients for *Disposable income*, our variable of interest. When controlling for age, gender and someone having a student status, the results indicate a negative correlation between being female and being a micro-mobility user, as well as a negative correlation between age and being a micro-mobility user. Looking at the chi-square statistic (prob > chi2), we can judge whether the tested model is better at describing the relationship between the variables than an empty model. The models in column (1) and (2) are not significant at the 5% level, indicating that the models do not fit our data well. Column (3) controls for the respondent's location; however, none of the variable's categories is significant at conventional levels.

Table 3: Regression results for all observations – Part 2

	Micro-mobility user	**Micro-mobility user**
	Logit AME (1)	**Logit AME (2)**
Log (disposable income)	0.049	0.046
	(0.072)	(0.070)
Gender	-0.134*	-0.117
	(0.079)	(0.081)
Age	-0.030**	-0.027*
	(0.015)	(0.017)
Education		
University (WO) Bachelor	0.251*	0.119
	(0.142)	(0.155)
University (WO) Master	0.269*	0.137
	(0.155)	(0.174)
Hogeschool (HBO) Bachelor	-0.255	-0.391*
	(0.196)	(0.194)
Foreign country – Master	-0.071	-0.066
	(0.288)	(0.284)
Location		
Outside the Netherlands		-0.157
		(0.133)
Rotterdam		-0.013
		(0.103)
Number of observations	135	135
Prob > chi2	0.0138	0.0192
Pseudo R^2	0.1011	0.1138

Notes: The (binary) dependent variable in the first column is measured as a proportion. The results are reported as average marginal effects (AME). The statistics shown are mean numbers. In parentheses, standard errors are reported. The reference category for the categorical variable *Education* is "Foreign country – Bachelor". The reference category for the categorical variable *Location* is "Netherlands (excluding Rotterdam)". Variables are coded as described in section 4.1.

*** Significance at the 1% level

** Significance at the 5% level

* Significance at the 10% level

Column (1) of Table 3 shows the regression output of the logit model extended by the dummy variables for *Education.* Attending or having recently graduated from a university bachelor or master programme in the Netherlands is associated with a higher predicted probability of being a micro-mobility user compared to the case of studying a bachelor's degree outside the Netherlands, ceteris paribus. Extending the model by the two *Location* dummy variables, we see that Hogeschool bachelor

is the only significant category among the *Education* dummies, and that pursuing this degree is associated with being less likely to belong to the group of micro-mobility users. Someone's place of residence does not seem to be correlated to micro-mobility usage. We need to be careful with interpreting the results as the change of significant dummy variables among the *Education* categories hints at multicollinearity, meaning that the *Education* and *Location* variables are likely linearly related. This makes sense as someone living outside the Netherlands is likely to pursue a foreign country bachelor or master, whereas we expect students living in the Netherlands to pursue one of the Dutch degrees.

4.2.2 Logit model for observations of disposable income below 2000€ monthly

Due to the rare occurrence of disposable incomes above 2000€ per month among students, the relationship between micro-mobility usage and disposable income was again plotted for disposable incomes below 2000€ per month. Figure 4 seems to showcase a stronger positive relationship between the two variables than the model with all observations; however, as mentioned before, the relationship tested is not linear due to the binary nature of the dependent variable.

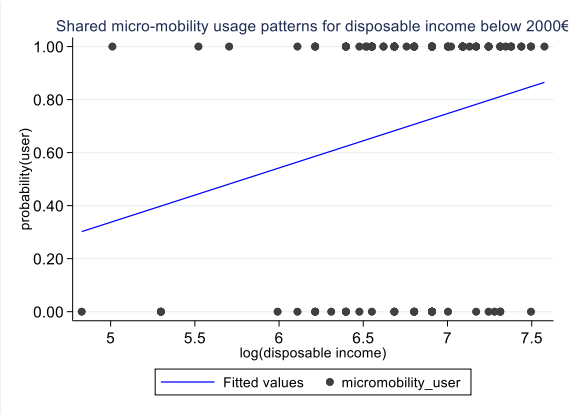


Figure 4: Plotted observations of shared micro-mobility users per logarithm of disposable income for all observations below 2000€/month. *Notes*: An observation of 1 indicates that the respondent has used at least one of the shared micro-mobility modes before, while 0 indicates that the respondent has not used any of the modes before. Log(disposable income) is shown in euros.

The same regressions as in Table 2 were run for observations of disposable income below 2000€/month (Table 4.3). The observations drop from 149 in the full model of section 4.2.1 to 134 in the models below.

Table 4: Regression results for disposable income below 2000€/month – Part 1

	Micro-mobility user	**Micro-mobility user**	**Micro-mobility user**
	Logit AME (1)	**Logit AME (2)**	**Logit AME (3)**
Log (disposable income)	0.188***	0.173***	0.151**
	(0.072)	(0.067)	(0.065)
Gender		-0.167**	-0.156**
		(0.076)	(0.077)
Age		-0.012	-0.015*
		(0.009)	(0.008)
Student		0.153	
		(0.150)	
Location			
Outside the Netherlands			-0.118
			(0.107)
Rotterdam			-0.031
			(0.101)
Number of observations	134	134	134
Prob > chi2	0.0163	0.0223	0.0253

Notes: The (binary) dependent variable is measured as a proportion in all three columns. The results are reported as average marginal effects (AME). The statistics shown are mean numbers. In parentheses, standard errors are reported. The reference category for the categorical variable *Location* is "Netherlands (excluding Rotterdam)". Variables are coded as described in section 4.1.

*** Significance at the 1% level

** Significance at the 5% level

* Significance at the 10% level

The regressions of columns (1) and (2) of Table 4 show significant positive coefficients for disposable income at the 1% level, suggesting that a percentage increase in disposable income is associated with a higher probability of having used shared micro-mobility in the past two years, all else equal. In column (2) and (3), being a female is associated with a lower predicted probability of being a micro-mobility user, ceteris paribus. The models in all three columns explain the effect on the dependent variable better than a model including only the constant.

Table 5: Regression results for disposable income below 2000€/month – Part 2

	Micro-mobility user	**Micro-mobility user**
	Logit AME (1)	**Logit AME (2)**
Log (disposable income)	0 .151***	0.160***
	(0.059)	(0.060)
Gender	-0.128*	-0.134*
	(0.078)	(0.079)
Age	-0.033	-0.033
	(0.025)	(0.025)
Education		
University (WO) Bachelor	0.225*	0.226
	(0.134)	(0.165)
University (WO) Master	0.315**	0.311*
	(0.143)	(0.183)
Hogeschool (HBO) Bachelor	-0.313*	-0.329*
	(0.185)	(0.197)
Foreign country – Master	-0.056	0.054
	(0.258)	(0.255)
Location		
Outside the Netherlands		-0.045
		(0.122)
Rotterdam		-0.063
		(0.104)
Number of observations	124	124
Prob > chi2	0.0028	0.0056
Pseudo R^2	0.1491	0.1517

Notes: The (binary) dependent variable in the first column is measured as a proportion. The results are reported as average marginal effects (AME). The statistics shown are mean numbers. In parentheses, standard errors are reported. The reference category for the categorical variable *Education* is "Foreign country – Bachelor". The reference category for the categorical variable *Location* is "Netherlands (excluding Rotterdam)". Variables are coded as described in section 4.1.

*** Significance at the 1% level

** Significance at the 5% level

* Significance at the 10% level

Table 5 shows the models of Table 3 for the modified observations. The model in column (1) indicates that a 1% increase in disposable income increases the predicted probability of being a micro-mobility user, all else equal, by 0.151%, which is a significant change at the 1% level. Again, being female is negatively correlated with micro-mobility usage. With respect to education, we find three significant

correlations. Compared to pursuing a bachelor's degree abroad (the reference category), pursuing a university bachelor's degree in the Netherlands increases the predicted probability of being a micro-mobility user by 0.225%, all else equal. All else equal, pursuing a Hogeschool bachelor in the Netherlands decreases this probability by 0,313% compared to the reference category. The changes are significant at the 10% significance level. Compared to a foreign bachelor, pursuing a university master's degree increases the predicted probability of shared micro-mobility usage by 0.315%, all else equal. Column (2) extends the model of column (1) by location dummies with the reference category "Netherlands (excluding Rotterdam)". While the coefficients for disposable income, gender and Hogeschool bachelor stay significant at the same level, the coefficient of university bachelor is no longer significant and the coefficient for university master is only significant at the 10% level. None of the added location dummies are significant. As explained in section 4.2.1, we likely suffer from multicollinearity among the variables.

4.3 The relation between frequency of usage and disposable income

The second sub-question we aimed to answer is the following:

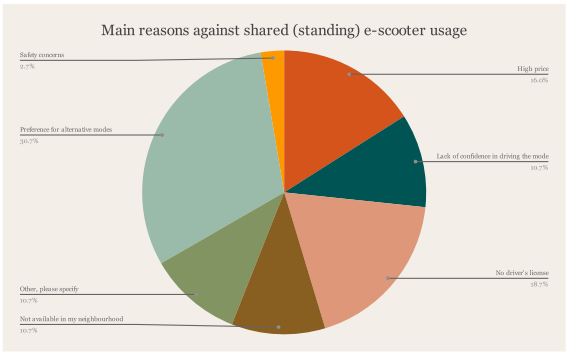
Does a higher income lead to more frequent usage of shared micro-mobility among young adults?

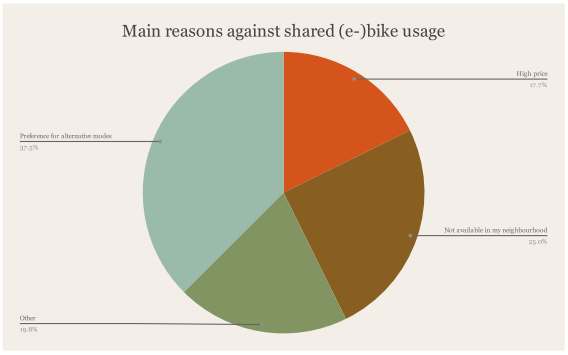
To test whether higher income is correlated with higher usage of shared micro-mobility, an ordered logistic regression per transport mode was performed. Ordered logistic regressions allow working with a categorical variable as the dependent variable, thereby granting the possibility to evaluate whether an increase in the treatment variable is correlated with a higher probability of the predicted value being in a "higher" category of the dependent variable. However, conducted chi-square (X^2) goodness-of-fit tests showed that correlations between the frequency of usage and disposable income variables were not present in the data, which might be due to the limited number of observations per individual shared micro-mobility mode. We thus concluded that the model did not fit the data at hand and suggest future research to investigate the relationship between frequency of usage and disposable income.

4.4 Underlying reasons for and against shared micro-mobility usage

To better understand the reasons against usage of shared micro-mobility modes, and more specifically whether price and availability are concerns for many, respondents were asked to indicate their main reason against shared e-scooter (including standing e-scooters) usage as well as their main reason against shared (e-)bike usage. Figures 5 and 6 show the frequency of the specific responses. The most frequent reason for not using the (standing) e-scooter modes is a preference for alternative modes, followed by not having a driver's license, high prices, lack of confidence in driving the mode and unavailability in the respondent's neighbourhood. Similarly, the main reason against shared (e-)bike

usage is a preference for alternative modes. Here, however, 25% of non-users mentioned that the modes were not available in their neighbourhood and for 17,7% the main determining factor against usage was the high price. The figure notes moreover outline additional unique reasons mentioned by respondents.





Figures 5 & 6: Main reasons against shared (standing) e-scooter and shared (e-)bike usage. *Notes:* The following reasons were mentioned under the category "Other" against shared (standing) e-scooter usage: risk of damage and responsibilities, having one's own transport modes, not having been in a situation where (standing) e-scooter usage would have been useful, not knowing of the existence of the modes, laziness to install the corresponding app, technical driver's license verification issues, and not needing these services. Against shared (e-)bike usage, the following reasons were mentioned under the category "Other": having one's own bike, usage too troublesome, safety issues with regards to lack of bike lanes and traffic in respondent's city, restricted choices to use shared micro-mobility, not having been in a situation where usage would have been useful, and disliking cycling.

The current non-users were moreover asked to indicate their main reason for considering adopting shared micro-mobility usage. This information will be helpful in determining factors of improvement to make shared micro-mobility usage more inclusive in the future. As shown in Figure 7, increased autonomy, time saving and having a travel "experience"/fun when using the modes were mentioned most frequently. Environmental friendliness, cost saving, and less crowded travel were also disclosed.

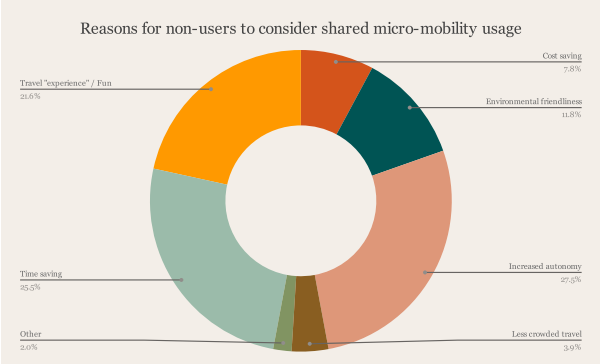


Figure 7: Non-users' main reasons to consider shared micro-mobility usage. *Notes*: Under the category "Other", one user indicated that he does not see any benefit in shared micro-mobility usage.

In section 8.1 of the appendix, more information on the trip purposes per mode can be found. Overall, shared e-scooters are most often used to visit family or friends, followed by using them to access leisure activities. For standing e-scooters, the majority of indicated trips includes leisure activities, e.g., using the modes for sight-seeing. E-bikes seem to be used for all four main purposes of meeting family and friends, commuting, running errands, and leisure activities almost equally alike. Lastly, shared bikes are most often used for leisure activities, they nevertheless also serve as a transport mode for meeting family and friends as well as commuting.

4.5 Relation between reasons against shared micro-mobility usage, disposable income, and owned vehicles

Table 6 shows the relation between non-users' answers to the question "What is your main reason against shared (standing) e-scooter usage?" and the average disposable income per answer chosen. High prices seem to disincentivize people with, on average, lower incomes, which is consistent with common expectations. Moreover, many of these people are the owners of a bike or car. Surprisingly, the average income of respondents indicating that shared micro-mobility is not available in their neighbourhood is the highest among all answer categories.

Table 6: Non-users' average disposable income and sum of vehicle owners per "main reason against shared (standing) e-scooter usage" category.

Main reason against shared (standing) e-scooter usage	Disposable income [€] (average)	Bike owner (sum)	Car owner (sum)	Motorcycle owner (sum)	E-bike owner (sum)
High price	910.83	10	5	1	0
Lack of confidence in driving mode	1,225.00	3	3	0	0
No driver's license	1,008.57	13	0	0	0
Unavailability in neighbourhood	1,362.50	3	6	1	0
Preference for alternative modes	1,031.82	20	5	2	1
Safety concerns	600.00	2	1	1	1
Other	1,084.38	7	2	0	0

Notes: The table shows mean and sum statistics of survey respondents who indicated that they were not a user of shared e-scooters or shared standing e-scooters. The category "Other" includes unique reasons as outlined in the figure notes of Figure 5.

Deciding against shared (e-) bike usage because of the high costs or unavailability does not seem to be affected by the respondents' level of disposable income to the same extent as for (standing) e-scooters.

Table 7: Non-users average disposable income and sum of vehicle owners per "main reason against shared (e-)bike usage" category.

Main reason against shared (e-)bike usage	Disposable income [€] (average)	Bike owner (sum)	Car owner (sum)	Motorcycle owner (sum)	E-bike owner (sum)
High price	1,100.00	13	4	1	0
Unavailability in neighbourhood	1,135.83	13	12	1	0
Preference for alternative modes	1,083.57	29	8	3	0
Other	1,168.06	16	7	2	2

Notes: The table shows mean and sum statistics of survey respondents who indicated that they were not a user of shared e-bikes or shared bikes. The category "Other" includes unique reasons as outlined in the figure notes of Figure 6.

Owning a specific vehicle might influence the usage of shared micro-mobility, as e.g., using shared bikes (at one's place of residence) when having one's own bike does not seem to make much sense. However, shared micro-mobility has been highlighted as part of a multi-modal transport system, in which multiple transport modes are used within one journey (Laa & Leth, 2020). The statistics from the thesis survey unfortunately do not provide enough information to evaluate whether ownership of a certain mode leads to a higher or lower usage of shared micro-mobility.

5. Discussion & Conclusion

The aim of this paper was to investigate the relationship between disposable income and shared micro-mobility usage among students and thereby answer the following research question:

Does income have an influence on shared micro-mobility usage among young adults?

As outlined in chapter 2, previous research has found that transport disadvantaged people are vulnerable to social, educational, and professional exclusion as long travel times and high travel costs can discourage or hinder people with a lower income to embark on certain trips. For young adults, it is crucial to have the ability to easily travel to higher education facilities as a degree lays a solid foundation for favorable work opportunities in the future. In the past three years, new transportation modes known as shared micro-mobility have been placed in many cities across the world. In this paper, the studied vehicles include shared e-scooters, standing e-scooters, bikes, and e-bikes. Usage of these modes has been promoted as an eco-friendlier way of transportation, while previous literature has also pointed out their potential for making areas which are badly connected to the transport network more accessible. Overall, the modes' potential for fairer and more efficient transportation is evident; however, to achieve its full potential in also serving lower income individuals who often live in less

accessible places or do not have the financial means for more “autonomous” transportation such as by car, shared micro-mobility needs to be reasonably priced. This paper therefore studied the relation between disposable income and shared micro-mobility usage using a sample of students from different countries.

5.1 Discussion of regression analyses

Logistic regressions showing average marginal effects and controlling for different variables were conducted for all observations of disposable income in the sample, as well as solely for observations of disposable income below 2000€ per month due to their more realistic description of average students’ disposable incomes. The logistic regression analyses presented in chapter 4 did not show a significant correlation between the variables when all survey observations were considered. Nevertheless, being female as well as having a higher age seem to be negatively correlated with usage of the modes (in model 1 of Table 2), all else equal. Previous research (e.g., Laa & Leth, 2020) has also found a prevalence of e-scooter usage among younger males, our results thus back these findings. Controlling for education, we find ambiguous results based on whether we also control for location, likely due to multicollinearity as mentioned before. When only considering young adults with a monthly disposable income of below 2000€, we found a significant relation between disposable income and shared micro-mobility usage at the 1% level. On average, a percent increase in disposable income seems to increase the predicted probability of being a shared micro-mobility user by 0,151% in the model of Table 5, column (1), ceteris paribus. We judged this model the most accurate as multicollinearity between the location and education variables is avoided.

Finding that, on average, a higher disposable income only positively influences shared micro-mobility usage when considering observations of disposable income below 2000€ monthly could be due to specific characteristics of our data. First, having a disposable income of above 2000€ per month is a rare occurrence among students and might be more prevalent among the survey respondents who are international students studying in the Netherlands. This group is likely to stem from richer families as financing living and studying abroad tends to be more costly than staying in one’s home country. Moreover, tuition fees were included in the approximation of disposable income, which are far higher for non-EU international students compared to EU-citizens but are often an expense considered as a necessary investment for ensuring good job prospects, even among less wealthy families. Not including these might have given us a more realistic picture of students’ “every day” disposable income. International students are moreover less likely to have a valid (EU) driver’s license, which is necessary for the usage of shared e-scooters. The analyses also do not control for whether someone lives in an urban or rural area. Since shared modes are still recent and primarily present in larger cities, we do not have a clear picture of whether the survey respondents with higher incomes tend to live in areas where

the modes are unavailable. Table 6 and 7 seem to indicate that this might be the case, as the average income of people who specified not using shared e-scooters or e-bikes due to unavailability of the modes in the person's neighbourhood is higher than the overall average income of all non-users. However, it might also be the case that students surpassing a certain income threshold prefer other ways of transportation such as traveling by car, which tends to be more expensive. This is known as the substitution effect. Having a car is often a "status symbol", while e.g., traveling by taxi requires less effort than other transportation. Thus, a higher income does not automatically imply increased usage of shared micro-mobility. Multiple reasons could thus explain the observed relationships.

5.2 Recommendations

Analyzing the underlying reasons of respondents choosing not to use shared micro-mobility, this study showed that many students simply prefer other modes of transportation. However, high prices as well as unavailability of the modes are also among the most frequently mentioned reasons for non-usage. Combining this with our findings that lower income individuals, at least up to a certain threshold, tend to be less likely to use shared micro-mobility, policy makers should consider improving the financial accessibility of shared micro-mobility for lower income students. As outlined in chapter 2, different micro-mobility companies have already partnered with public institutions to offer different subscription models based on someone's income, which could help incentivize poorer individuals to start using the modes. An idea would be to integrate the usage of shared micro-mobility into the free public transport deal that Dutch students are eligible to acquire; however, balancing the economic and social feasibility of such deals tends to be difficult. Having better financial access to shared micro-mobility will allow students to save time traveling and be more autonomous, which also entails better connectedness to any "transit deserts". Policymakers should moreover consider incentivizing shared micro-mobility providers to expand their operations to areas that are more remote or less connected to the transport network, such as certain suburban areas, as previous research as well as this paper's insights on reasons for current non-users to consider using the service in the future have shown the modes' potential for improving travel efficiency. It would be mutually beneficial for micro-mobility companies to expand to areas where transport inequalities with regards to long travel times and inadequate connectedness impact many people, as the habitants of these areas would be at a lower risk of social exclusion stemming from transport disadvantages while micro-mobility providers are expected to have a large prospective customer base (provided their services are reasonably priced).

6. Limitations & Suggestions for Future Research

The limited number of observations makes it difficult for us to draw clear conclusions from the survey. There might be income and/or usage differences between countries which are not reflected in our

results, potentially creating biases that we are not aware of while also limiting the external validity of our study. The Netherlands has a strong cycling culture accompanied by a high-quality cycling infrastructure, and scooters are allowed to be driven on bike lanes. This might encourage usage of shared micro-mobility, while countries where scooters are part of the regular road traffic might have natural disadvantages for encouraging usage of the modes. Moreover, as mentioned before, the data does not show whether someone lives in an urban or rural area, indicating that factors we did not control for are likely to also influence whether someone is a shared micro-mobility user. In our data, users of shared micro-mobility were also overrepresented compared to non-users, which could potentially harm the accuracy of our results; thus, future research should aim at better balancing the two groups.

This research did not account for possible transport effects on disadvantaged groups other than lower income students. In most cities, it is allowed to park shared micro-mobility anywhere on sidewalks, or the modes are simply parked anywhere without consideration, resulting in blocked sidewalks due to the parked vehicles (NACTO, 2020) and thereby limiting the mobility of other disadvantaged people such as wheelchair users. The transport needs of one group are thereby put above the ones of another group, which re-establishes transport inequalities. Policymakers thus need to be careful with maintaining a holistic picture of individual transport needs when creating usage incentives for certain types of transportation.

Future research should further investigate the relation between disposable income and shared micro-mobility usage by using a larger sample size, controlling for additional factors influencing usage, and getting more accurate figures of people's disposable income. It is important to consider that while students usually have low incomes, they do not necessarily have a low socio-economic status (Caspi et al., 2020), suggesting that promoting the usage of shared micro-mobility might create even greater advantages when done among the actual population of lower socio-economic status. Further research should thus also conduct the analyses of this paper with the latter group.

In this paper, we moreover did not achieve to investigate the relation between frequency of using shared micro-mobility and disposable income. This seriously impacts the results of our analysis, as someone who has used shared micro-mobility once before is treated the same as someone who is using it daily. Further research should therefore differentiate between different types of users to get a more accurate picture of how income impacts shared micro-mobility usage patterns.

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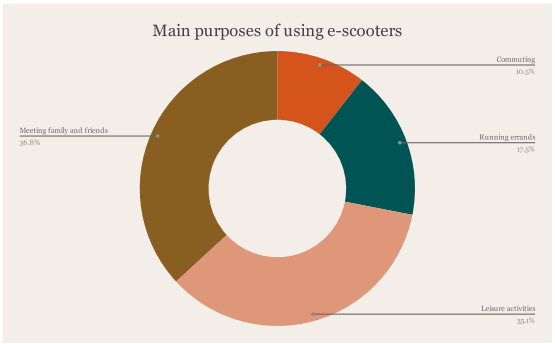
8. Appendix

8.1 Main usage purposes per shared micro-mobility mode



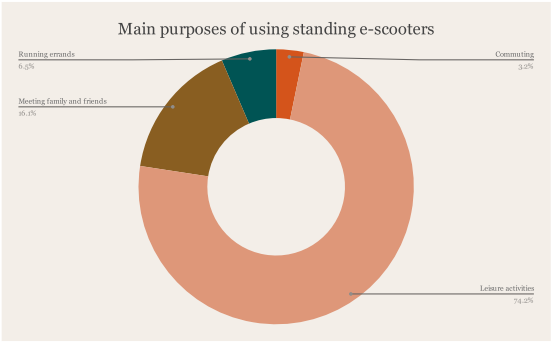
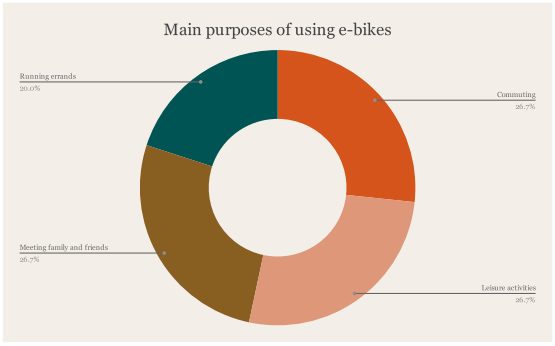


Figure 8 & 9: Survey respondents' main purposes of using shared e-scooters and shared standing e-scooters.



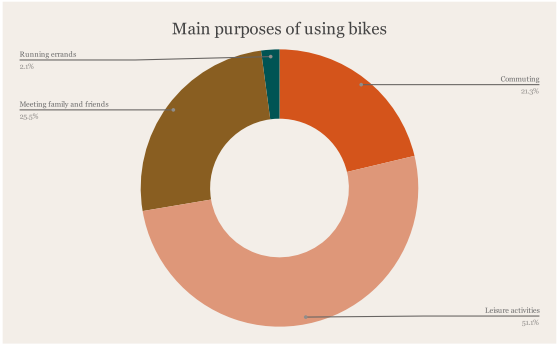


Figure 10 & 11: Survey respondents' main purposes of using shared e-bikes and shared bikes.

8.2 Thesis Survey – Shared Micro-mobility

Introduction

Thank you for participating in this study!

For my bachelor thesis, I am conducting research on shared micro-mobility usage. In the following, you will be asked several questions on your usage of shared micro-mobility as well as general follow-up questions about your demographic background.

- Your participation in this study is voluntary and you may quit at any time.
- Your data remains confidential and is treated anonymously.
- Responses you provide will be analyzed in the aggregate only and your individual responses will not be revealed.

  If you have any questions, please send an email to 510918hh@student.eur.nl.

Background

Shared micro-mobility is the umbrella term for shared e-scooters (moped-like, e.g. Felyx), standing e scooters (e.g. TIER), bikes and e-bikes. In this research, only dock-less vehicles that can be parked anywhere within the service area are considered.

Q1 Which of the following shared micro-mobility modes have you used in the last 2 years?

- Shared e-scooters
- Shared standing e-scooters
- Shared e-bikes
- Shared bikes
- None

Q2 What is your **main reason** for not using shared (moped-like/standing) e-scooters?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = None

Or If

Which of the following shared micro-mobility modes have you used in the last 2 years? != Shared e-bikes

And Which of the following shared micro-mobility modes have you used in the last 2 years? != Shared bikes

- High price
- Not available in my neighbourhood
- Preference for alternative modes
- Safety concerns
- No driver's license
- Lack of confidence in driving the mode
- Other, please specify _____

Q3 What is your **main reason** for not using shared (e-)bikes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = None

Or If

Which of the following shared micro-mobility modes have you used in the last 2 years? != Shared e-scooters

And Which of the following shared micro-mobility modes have you used in the last 2 years? != Shared standing e-scooters

- High price
- Not available in my neighbourhood
- Preference for alternative modes
- Other, please specify _____

Q4 On average, how often have you use shared e-scooters in the last 2 years?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-scooters

- Every day

- 3 times a week
- Once a week
- A few times a month
- Less than once a month

Q5 On average, how often have you used shared standing e-scooters in the last 2 years?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared standing e-scooters

- Every day
- 3 times a week
- Once a week
- A few times a month
- Less than once a month

Q6 On average, how often have you used shared e-bikes in the last 2 years?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-bikes

- Every day
- 3 times a week
- Once a week
- A few times a month
- Less than once a month

Q7 On average, how often have you used shared bikes in the last 2 years?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared bikes

- Every day

- 3 times a week
- Once a week
- A few times a month
- Less than once a month

Q8 Generally speaking, what is your **main purpose** of using shared e-scooters?

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-scooters

- Commuting to work/school/university
- Meeting family and friends
- Running errands [e.g. (grocery) shopping]
- Leisure activities [e.g. sightseeing on vacation]
- Other, please specify _____

Q9 Generally speaking, what is your **main purpose** of using shared standing e-scooters?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared standing e-scooters

- Commuting to work/school/university
- Meeting family and friends
- Running errands [e.g. (grocery) shopping]
- Leisure activities [e.g. sightseeing on vacation]
- Other, please specify _____

Q10 Generally speaking, what is your **main purpose** of using shared e-bikes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-bikes

- Commuting to work/school/university
- Meeting family and friends
- Running errands [e.g. (grocery) shopping]
- Leisure activities [e.g. sightseeing on vacation]
- Other, please specify _____

Q11 Generally speaking, what is your **main purpose** of using shared bikes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared bikes

- Commuting to work/school/university
- Meeting family and friends
- Running errands [e.g. (grocery) shopping]
- Leisure activities [e.g. sightseeing on vacation]
- Other, please specify _____

Q12 Generally speaking, where do you see the **main advantage** of using shared e-scooters?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-scooters

- Time saving
- Cost saving
- Less crowded travel
- Environmental friendliness
- Travel "experience" / Fun
- Increased autonomy (going anywhere vs. ending up at a specific train/tram/bus stop or parking lot)
- Higher time-reliability

- Other, please specify _____

Q13 Generally speaking, where do you see the **main advantage** of using shared standing e-scooters?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared standing e-scooters

- Time saving
- Cost saving
- Less crowded travel
- Environmental friendliness
- Travel "experience" / Fun
- Increased autonomy (going anywhere vs. ending up at a specific train/tram/bus stop or parking lot)
- Higher time-reliability
- Other, please specify _____

Q14 Generally speaking, where do you see the **main advantage** of using shared e-bikes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared e-bikes

- Time saving
- Cost saving
- Less crowded travel
- Environmental friendliness
- Travel "experience" / Fun
- Increased autonomy (going anywhere vs. ending up at a specific train/tram/bus stop or parking lot)
- Higher time-reliability

- Other, please specify _____

Q15 Generally speaking, where do you see the **main advantage** of using shared bikes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = Shared bikes

- Time saving
- Cost saving
- Less crowded travel
- Environmental friendliness
- Travel "experience" / Fun
- Increased autonomy (going anywhere vs. ending up at a specific train/tram/bus stop or parking lot)
- Higher time-reliability
- Other, please specify _____

Q16 What would be your **main reason** to consider using one of the shared micro-mobility modes?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = None

- Time saving
- Cost saving
- Less crowded travel
- Environmental friendliness
- Travel "experience" / Fun
- Increased autonomy (going anywhere vs. ending up at a specific train/tram/bus stop or parking lot)
- Higher time-reliability
- Other, please specify _____

Q17 Considering your answer to the previous question, which shared micro-mobility mode would you most likely try out?

Display This Question:

If Which of the following shared micro-mobility modes have you used in the last 2 years? = None

- Shared e-scooters
- Shared standing e-scooters
- Shared e-bikes
- Shared bikes

Q18 Which of the following vehicles do you own?

- Bike
- E-bike
- Scooter
- E-scooter
- Standing scooter
- Car
- Motorcycle
- None of the above

Q19 Approximately, what is your disposable income per month?
(The money that you have available for rent, tuition fees, food, leisure activities etc. per month. This could e.g. be the amount of money you receive from your parents, a side job and/or a student loan each month.)

Q20 Do you own an OV-chipkaart for free public transport usage during the week or weekend?

- Yes
- No

Q21 What is your age?

_____

Q22 What is your gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Q23 Where do you live?

- Rotterdam
- Netherlands (excluding Rotterdam)
- Outside the Netherlands

Q24 Please choose your district.

Display This Question:

If Where do you live? = Rotterdam

▼ Kralingen (1) ... Waalhaven-Eemhaven (22)

Q25 Are you a student?

- Yes
- No

Q26 Which education level are you currently working towards?

(If you already graduated from higher education, what is the highest diploma you received?)

Display This Question:

If Are you a student? = Yes

▼ University (WO) - Bachelor (1) ... Other (9)

Q27 Do you have a physical impairment?

- Yes
- No
- I prefer not to say