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Mobility subsidies and distributive justice – case study of Budapest

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Car use dominates inner cities worldwide and this car domination reduces the quality of life through public space consumption and air and noise pollution to a relatively great extent. It is widely acknowledged that to reduce these problems the external costs of car use (costs that are not borne by the car user but imposed on society) should be internalized, and tax exemptions and subsidized prices should be ended. However, as these measures would entail significant price rises, they are considered unpopular and so rarely implemented. This research aims to explore through a detailed case study the consequences if all external costs, tax exemptions and subsidized prices of motorized transport are considered as subsidies and the distribution of these subsidies is viewed through the lens of distributive justice. The research hypothesizes that in this case the distribution of mobility-related subsidies can be shown to be unjust, as the inequalities in distribution are based neither on desert nor need and, further, that redistributing them might be popular or at least publicly acceptable. Thus, as redistributions would entail higher prices for car use due to subsidy reductions, they would result in lower car domination. Based on this line of reasoning the research aims to explore (1) the mobility-related subsidies in the case of inner city residents and workers of Budapest, (2) how (un)just the distribution of these subsidies is, and (3) how the public perceives the distribution and potential redistributions of subsidies. Mobility-related subsidies include unspecific subsidies (e.g. the external costs of climate change or resource use), air pollution subsidies, parking subsidies, public transportation subsidies and commuting subsidies and the estimation of their unit values (per km, or per year in the case of parking) are based on widely accepted studies and legal regulations. Regarding the distribution of mobility-related subsidies, representative characters with distinct mobility patterns are created and the annual amount of mobility-related subsidies they receive is calculated based on the unit values of subsidies and the mobility patterns of these characters. Then I investigate whether the annual amounts of subsidies are markedly different in the case of different characters, and if they are, whether the differences can be explained by the desert or need of the characters. Finally, I explore the public views regarding the current distribution and potential redistributions of subsidies in the case of parking. The findings suggest that the distribution of mobility related subsidies is indeed unjust, and most people can perceive this injustice and would support a more equal distribution of mobility related subsidies. Based on these findings I formulate policy recommendations that would redistribute the mobility related subsidies by raising the prices of motorized mobility in Budapest metropolitan areas and providing equal or need-based monetary subsidies. Finally, I briefly consider the potential barriers to introducing such policies.

Keywords: inner city, car domination, subsidy, distributive justice

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1 INTRODUCTION

1.1 The problematique

This research is inspired by the problematique of car domination in inner cities. Car domination refers to the complex overwhelming impact of car traffic and car parking on the urban structure and life in inner cities. Inner cities are defined here as the central part(s) of metropolitan areas[1] where densely-built multi-storey buildings dominate, allowing a high density of residents, jobs and services. Though this is a rather vague definition, a more precise one is not feasible due to the high variation of urban structures. What is important in terms of car domination is that in such centres, there is a large demand for space and a high density of movements due to their high inhabitant, job and service density; they have relatively small size[2]; and they are usually poorly ventilated and strongly reverberant due to the many high-rise and sound-reflecting buildings. Cars are defined here as large[3], potentially high-speed, privately and mostly individually used vehicles (so e.g. taxis and carsharing are not included). The problematique refers to the substantial contribution of cars to the many negative aspects of quality of life in inner cities, such as the lack and low-quality of public spaces and greenery, the fragmentation of urban area, the high cost of space, the increased risk of accidents, poor air quality, noise, etc. due to the space requirements and air and noise pollution of many cars[4] .

The contribution of cars' space requirement to these negative aspects is best illustrated if the inner city space is divided into two categories: *vehicular spaces*, such as roadbeds, bike-only paths, tram tracks, parking areas, etc. and *non-vehicular spaces*, such as the majority of buildings

[1]Metropolitan areas are areas that share industry, infrastructure and housing (Squires 2002)

[2] The size of the urban centre is highly varied and depends on the size of the metropolitan area and other factors. However, the population density quickly decreases beyond a 5 km distance from the city centre point in most cities (Bertaud and Malpezzi 2003); it can be assumed that jobs and services are even more concentrated.

[3]Large refer to larger size of cars compared to individually used travel vehicles, such as bikes, segways, etc.

[4]Certainly, the large CO2 emissions, the contribution to obesity, etc. are also the negative aspects of car use but these aspects do not have a particularly pronounced impacts in inner cities compared to other areas.

(including gardens, front yards, backyards, inner yards belonging to certain buildings), pavements, parks, squares, playgrounds, playing fields, pedestrian areas, etc[5]. The two spaces are markedly different in their function as while the function of most non-vehicular spaces is to provide space for primary human activities, such as working, playing, relaxing, socializing, etc., the vehicular spaces are unavailable for such activities as illustrated by Fig. 1. and their only function is to provide access for vehicles to non-vehicular spaces[6]. It could be said that vehicular space is derived space, similarly to when transport demand is called derived demand. As the sum of vehicular and non-vehicular space is fix, any increase of vehicular space can occur at the expense of non-vehicular space. Thus the derived character of vehicular space entails that in order to increase quality of life cities should aspire to satisfy their mobility needs with as less vehicular space as possible.

[5]Certainly there are spaces that could be classified both vehicular and non-vehicular space, such as streets with speed limits in the range of walking speed, but they are usually rather scarce.

[6]Vehicular movement is regarded as a derived activity here. Though some vehicular movement, such as cycling or driving for the sake of pleasure or competition can be regarded as primary human activity, such kind of vehicular movements are likely to be rather limited in inner cities due to the hassle of city centre traffic.

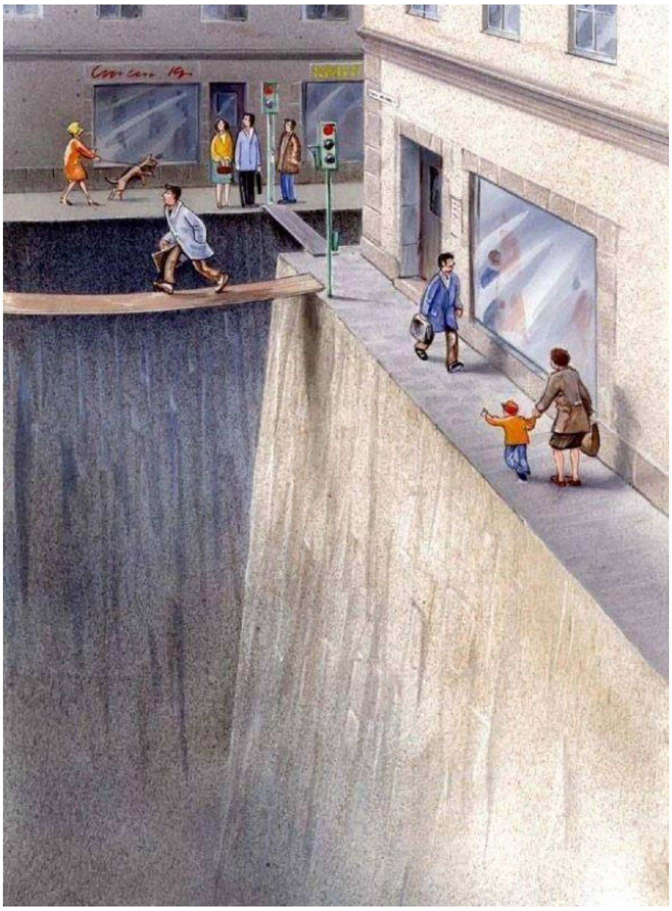


Figure 1. Illustration of the unavailability of vehicular spaces for pedestrians (Yilg 2014)

However, cars demand much more vehicular space per transported people per unit of time compared to other vehicular traffic options, such as public transportation and cycling (Goodwin 2012), because cars carry an average of 1.55 people in the U.S. and Western Europe (Transportation Energy Data Book 2009, EEA 2010) and 1.3 people in Budapest (Városkutatás Ltd. 2009), are unused for 97% of the time[7] (Zijlstra and Avelino 2011) and are substantially larger than bikes (or other individually used vehicles). As public transportation vehicles carry large numbers of people, particularly in inner cities and are used a much larger fraction of the time[8], their vehicular space per

[7]This figure might be questionable and is likely to vary across countries and time. In Hungary the average annual VKT of cars was 16,300 km (Bosch Media Service 2014). Assuming the average speed being in the range of 30-60 km, it took 272-543 hours for a car to cover that distance which is the 3.1-6.2% of the year (8760 hours); so cars were likely to be unused in the 93.8-96.9% of the time in 2014 in Hungary.

[8]The exact figure is likely to vary across countries and time. According to the annual report of the public transport operator in Budapest (BKV 2010), 2820 vehicles covered 176 million km at the speed of 16.24 km/h in 2010. It means that the average vehicle was used for 3843 hours which is the 43.9% of the year.

transported people per unit of time is likely to be much smaller (that is while an average car is likely to transport on average less than 2 persons a day, an average bus, five-ten times larger, is likely to carry hundreds or thousands of people a day). And while bicycles usually carry only one person and are also likely to be unused for the overwhelming majority of the time, their much smaller size, smaller inter-vehicle space requirements due to lower speed and their portable nature requires much smaller vehicular space (Litman 2009), particularly when not used. That is while the parking of a car might require even 30 m^2 (Manville and Shoup 2005, Litman 2009)[9], such a space can easily accommodate at least 10 bikes (Litman 2009); in addition bicycles can be stored in non-vehicular space, such as in buildings or in yards. As a result, cars can consume 94% of road space[10], as demonstrated by Servant in the Paris region (Servant 1996, cited by Camagni et al. 2002) and large parts of cities' land is devoted to vehicular spaces, as demonstrated by the case of London and Los Angeles, where about one-quarter and nearly the half of the land is covered by vehicular spaces, respectively (Sheller and Urry 2000). Then the large share of vehicular space substantially lowers the quality of non-motorized-traffic activities in inner cities through the following mechanisms. First, obviously, it considerably reduces the potential supply for non-vehicular spaces that can contribute to the over-use of those spaces. Secondly, vehicular spaces raise the walking distances among facilities by allowing the crossing of linear vehicular spaces (streets) only at certain sections and sometimes in inconvenient ways (through under- or overpasses), and by occupying spaces (parking lots) between facilities. Thirdly, as vehicular spaces are designed for large and high-speed vehicles, they make inner cities less attractive (Jacobs 1961). Fourthly, as vehicular spaces are potentially dangerous for humans, they reduce the attractiveness of cycling and require much more

[9]This figure refers to parking lots where circulation of cars within the plot require considerable spaces, too, and to the United States where the cars are likely to be larger than in Europe or in Hungary. Curbside parking of small cars is likely to require less than half of this space.

[10]Note that this data refers only to road-space; the space consumption of cars in terms of parking space/hour is likely to be even higher (probably above 99%).

intensive supervision of small children (and adult humans with reduced capacity to apply rules) or their isolation from public spaces.

The space requirement of car use is also responsible for congestion as the higher the share of cars through a given road capacity is, the larger the space requirement of the traffic is, and so the more likely and severe the congestion is, due to a mismatch between the given and required space. Congestion then reduces the quality of other activities by hindering access to them. Moreover, the extensive and exclusive space requirement frequently leads to inequality issues, as it entails dedicating a large share of public spaces (most roadbeds and public parking places) to a certain fraction of the population (car users).

These negative impacts are inherently associated with intensive car use as they stem from a fundamental attribute of cars - their large space requirement. At present, however, car use in inner cities is also responsible for significant air and noise pollution due to the polluting character of most cars and the concentration of car use in a relatively small and typically weakly ventilated areas (Yim and Barrett 2012). Air pollution related to car use is responsible for millions of deaths per year (UN Habitat 2013, Greene & Wegener 1997), a high share of which likely relates to inner cities[11]. Though the air pollution of cars is decreasing due to better or alternative technology of new vehicles, this impact is expected to remain significant for at least some decades due to the slow turnover of the car fleet.

Certainly, car domination is also problematic outside the inner city. However, in inner cities, the context of car domination is fundamentally different from that of suburbs or rural areas. As indicated above, in inner cities the intensive car use significantly reduces the quality of place through air pollution and requiring less attractive space at the expense of humanized outdoor space, and the alternative travel modes, such as non-motorized transport or public transportation are

[11]Though there are no available statistical data of car-use related air and noise in inner cities, it can be assumed that cars cause relatively more problems in inner cities than outside the city centre due to the more concentrated nature of car use.

relatively comparable (or in some cases even better) to car use in terms of speed, convenience, and flexibility due to the small distances and large travel densities. In the suburbs or in rural areas car use does not reduce significantly the quality of place as traffic is not concentrated and there is plenty of public and private outdoor space and alternative travel modes are not that competitive with car use due to the large distances and low travel densities.

But what are the drivers of inner city car use? From an economic perspective, whether a person uses the car in the inner city or not depends on how the private utility of inner city car use relates to the alternatives. The relative benefits of inner city car use compared with other transport modes are rather obvious. Most importantly, car use is inherently quicker and more convenient than any of its alternatives in the case of many trip, and so its costs associated with the time requirements and inconvenience of the trip are lower than in the case of its alternatives. Secondly, car use is also more flexible than public transportation, as it is not constrained by schedules and more flexible than cycling, as it is suitable for short and long trips, as well. Thirdly, cars allow the transport and safe temporary storage of large amounts of potentially heavy or sizeable items that would be cumbersome otherwise, and they allow families, couples or friends to travel together in a private space which facilitates private and joint activities without potentially disturbing others. Last but not least, cars can represent status, personality, etc. and due to their positive characteristics, such as aesthetic appearance, power, quickness, etc. they can satisfy their owners.

The main cost of most desired human activity is its price. For instance, though probably the majority of people would like to dine regularly in luxury restaurants, to buy high-quality products or to spend their vacation on tropical islands, etc., they do not do so because these activities are rather expensive. It is widely acknowledged that inner city car use is higher than optimal because its price does not reflect its social costs (Banister 1994, Maibach et al. 2008); that is a market distortion occurs. Namely, at the societal level car use is costly in the sense that, besides the monetary costs covered by the car users or other private entities (e.g. by employers), it entails a lot of external costs (e.g. the cost of air pollution, climate change, etc.) and subsidies (e.g. discounted parking prices for residents, commuting subsidies), which are borne by society and not by the car users. These costs (the external costs and subsidies) are referred to as public costs[12] in the dissertation to differentiate them from social costs (private costs and external costs), private costs (non-monetary costs borne by the user and monetary costs that are actually paid in order to pursue the activity), external costs (costs borne by a third party who did not agree to it) and conventional subsidies (monetary costs that are paid from public resources). Note that conventional subsidies are private monetary costs that are not paid by the users. The private costs borne by the users are referred to as individual costs in the dissertation. Thus social costs can be interpreted as the sum of individual costs and public costs. Note that the social costs of public transportation can be divided to individual costs and public costs, too.

The public costs of car use are substantial: according to the report of de Bruyn & de Vries (2020) the average external costs of air pollution in 432 European cities alone exceed a thousand EUR/capita/year. And air pollution of car use tends to be more severe, and the value of public space tends to be higher in the inner part of large cities compared to the outer parts; thus public costs are likely to be even higher there. If these public costs were to be paid by the car users, inner city car use was much more expensive, and so the net utility of car use (the individual benefit minus the individual costs) would be much lower and so car use would be probably much less intensive (Banister 1994). Thus the lack of payment for the public costs encourages more intensive car use and then amplifies the negative aspects of car use. In addition, it generates a vicious circle of urban sprawl: the amplified negative aspects and the low individual monetary costs of car use (and other motorized transport) prompt people to reside farther from inner cities which results in more intensive car use due to more commuting by car and so even lower quality of inner city life

[12] Note that public costs are different from social costs that includes private costs, too. And they also differ from external costs as they include subsidies that are not considered as external costs. Public costs can be considered as the sum of external costs and subsidies, the latter including monetary subsidies, discounted prices, tex exeptions, etc.

(Petersen 2004), a process named by Jacobs as the 'erosion of cities' by the automobile in her highly influential book titled 'The death and life of great American cities' (1961).

Though the lack of payment for the public costs of car use is acknowledged as a primary barrier to reducing the negative impacts of car use by most experts (see above), instead of requiring the car user to cover these costs, the usual policy response[13] is a second-best policy, that is, the creation of another market distortion to reduce the negative effects of the original one. One of the most frequently applied market distortions is the provision of quick, convenient and subsidized public transportation (Börjesson et al. 2020), hoping that it will prompt many car users to switch to public transportation. It is rather doubtful, however, whether this policy can reduce inner city car use to a substantial extent for two reasons. First, though public transportation developments and subsidies might reduce the competitive advantage of car use compared to public transportation to some extent, the net utility of car use is likely to remain higher than that of public transportation in most cases due to the inherent relative benefits of car use and the lack of payment for its public costs. Secondly, public transportation developments and subsidies encourage urban sprawl that increases mobility demand. Thus, even if the modal share of car use decreases due to public transportation developments and subsidies, the volume of car use is likely to decrease to a lesser extent or even grow as the volume of motorized mobility increases due to urban sprawl. E.g., if public transportation subsidies and developments reduce the modal share of car use between the suburb and the city from 60% to 50%, but at the same time such changes increase the number of commuters by 20%, then the volume of car use is likely to remain the same. Another market distortion is the subsidizing of electric cars that might reduce the air pollution of cities, but does not reduce the public space consumption of cars. Further second-best policy options include cycling subsidies, carsharing subsidies, teleworking subsidies, housing subsidies in inner cities, etc. Though

[13] Certainly, first-best policies – e.g. environmental taxes on fuel, road fees, congestion charges, etc. - are also applied to reduce car use-related problems, but much rarer than second-best policies.

all these options might reduce the negative effects of car use in the inner cities, they are unlikely to do so to a significant extent as they do not reduce the relative advantage of car use sufficiently.

Certainly, there are other potentially effective policies to reduce the problems of car use other than requiring the payment for its public costs. E.g., the introduction of low emission zones, reducing road space and/or on-street parking space, limiting the number of cars entering the inner city are all effective policy options for reducing car use in the inner city. However, this research focuses on the first-best policy option, that is, on reducing the market distortion of car use in the inner city by requiring the payment for its public costs.

The primary reason of not applying this first-best policy is the common belief according to which such requirement is not supported by the majority - as it raises the price of car use and any price rise is unpopular (Beiser-McGrath and Bernauer 2019)-, and so it is politically risky to make car users cover the costs of their car use (Banister 1994). Nevertheless, the lack of payment for public costs can be contextualized in a different way, too. If the public costs of mobility are regarded as forms of subsidy provided for mobility users, then the mobility user's contribution to the external costs of mobility and his or her share from unpaid private costs count as personal subsidies. In this case the following three hypotheses can be set up:

(1) The distribution of mobility subsidies is unjust.

According to Miller (1999) the distribution of public resources is just if it is based on desert, need or equality. However, as mobility is a basic human activity, desert is considered to be an irrelevant criterion in the case of mobility[14]. Therefore, need and equality are the only relevant criteria in the case of just mobility subsidies. As the share from the public costs of mobility is likely to be determined by the motorized transport pattern of a person, it can be assumed more mobility entails more public costs. Thus, if public costs are regarded as subsidies then people with higher

[14] It would be strange if outstanding people would receive mobility subsidies. Distribution of subsidies based on desert is usually confined to scholarships or awards for outstanding persons.

motorized mobility use are likely to receive more subsidies than non-car-users and people with lower mobility use, respectively, i.e. the distribution of subsidies in unequal. As it is unlikely that people with higher mobility use are all in need, the distribution of subsidies is unlikely to be based on the relevant principles of distributive justice. That is, the distribution of mobility related subsidies is likely to be unjust.

(2) If current distributions of mobility subsidies are indeed unjust, then most people would prefer the equal or need-based redistribution of mobility-related subsidies.

The equal or need-based distributions are more just that the current distribution of mobility-related subsidies and most people are likely to prefer just distributions to unjust ones (Miller 1999).

(3) Equal or need-based redistributions of mobility-related subsidies would entail less car use and less motorized mobility

As the equal or need-based redistributions of subsidies are likely to entail substantially higher car use prices (and in general higher motorized mobility prices), less car use and less motorized transport use are expected, and so inner city car domination is likely to decrease.

If these hypotheses are true, then such contextualization can raise the possibility of potentially popular subsidy reforms that aim to redistribute the subsidies in a fairer way, and as a side-effect it would reduce inner city car domination, too. Such subsidy reforms – that aim more just subsidy redistributions - have taken place primarily in oil-producing developing countries. In these states the price of fuel was much lower than the global market price, and so subsidized prices resulted in direct and substantial losses of the state budgets as less oil could be sold in the international market due to the increased domestic consumption and in some cases due to smuggling into neighbouring countries (Schaffitzel 2011, Guillaume et al 2011, Sarrakh et al 2020). On the other hand, as the lack of payment for external costs (or for certain other public costs) of motorized mobility by users have not been typically regarded as subsidies (the reasons why developed countries do not regard public costs as subsidies are explored in Chapter 2), no such subsidy reforms have been proposed or studied in the developed states.

Still, developed countries apply policies that require payment for public costs and use the revenues to provide direct benefit for citizens; such a policy is called revenue recycling (Beiser-McGrath and Bernauer 2019). The main differences between subsidy distribution and revenue recycling are that the latter does not regard public costs as subsidies and so does not aim to improve justness by redistributing the subsidies on the basis of just principles. The primary objective of revenue recycling is to achieve sufficient public support (Beiser-McGrath and Bernauer 2019). Therefore, revenue recycling is not necessarily based on equality or need, in fact it usually manifest in labour tax cuts that benefit only those who pay such taxes. But as it still benefits many people, and as labour tax cuts are considered advantageous for the economy, revenue recycling policies are usually popular (Carratini et al. 2019).

1.2 Research aim

This research aspires to scrutinize the potential consequences if mobility-related public costs were regarded as subsidies given to mobility users in Budapest, and the distribution of these subsidies was viewed through the lens of distributive justice. That is, the primary research objective is to test the above three hypotheses in the case of Budapest. The case study approach was chosen as mobility-related subsidies and their distribution are likely to differ in different cities and so an approach that would address cities in general was not possible. And Budapest was selected, as it is the researcher’s place of residence in the last 20 years that could facilitate the research design and data collection to a great extent. By testing the hypotheses, the research aims to understand how inner city car domination could be reduced by seeking to attain a more just distribution of mobility-related subsidies.

To test the hypotheses, the research first aims to explore the current distribution of subsidies among the residents and workers of the inner city of Budapest that requires assessing the amount of subsidies different individuals receive. Then it intends to explore how the distribution relates to distributive justice and how the subsidies could be redistributed more justly. Finally, the research aims to explore the public views about the current distribution of car use related subsidies and the public support of potential redistributions of parking subsidies, as substantial public support is considered as a pre-requisite to any subsidy reform (Carratini et al. 2019).

The research differentiates the terms of subsidy reduction, revenue recycling and subsidy redistribution. Subsidy reduction refers to measures when the revenues and/or freed resources generated by subsidy reduction (e. g. internalization of external costs, terminating tax exemptions, raising discounted prices or fees) are spent on public projects (e.g. on public transportation, education, healthcare, etc.). Revenue recycling plans to offset the negative attitudes towards environmental taxes by providing direct benefits for citizens by using the revenues generated by the environmental taxes. Its primary aims are to achieve public support and to generate higher economic output by lowering labour tax rates. The primary objective of subsidy redistributions is to distribute the subsidies on a just way by providing freely consumable subsidies (e.g. money or coupons). As this research focuses on the role of distributive justice, it aims to explore the effects of more just subsidy redistributions. Therefore, it considers the current level of subsidies as granted and primarily investigates the effect of budget-neutral redistributing those subsidies, since if the redistribution would not take place in a budget-neutral way (that is the volume of subsidies was reduced), then the effects of subsidy redistributions could not be differentiated from the effects of subsidy reductions. Certainly, I agree that certain developments – e.g. transforming former traffic-accommodating roads into pedestrian zones or rehabilitating brownfield areas, etc. – are necessary for reducing car domination in the inner city and require public financial resources, but the revenues generated by potential subsidy reductions are not the only option to raise that resources. Subsidy redistributions and raising funds are two independent things and the fact that subsidy reforms resulting in reduced car domination in the inner city generate revenues does not mean that developments aiming car domination reduction in the inner city should be funded from such revenues. Thus the research does not aspire to explore how public developments should be funded or whether spending revenues on public developments is more effective than recycling or redistributing them. Finally, another reason for not focusing on subsidy reductions is that they are unlikely to be implemented due to their unpopularity in most of the cases.

The research neither aspires to explore the potential impact of revenue recycling as, from a distributive justice perspective, they are less just than subsidy redistributions since they benefit those who pay taxes and/or those who pay more taxes. In addition, subsidy transformations of urban mobility related subsidies are complicated as subsidy transformations require the modification of the national tax regime that is the responsibility of the state and so is not in the agency of the decision-makers of metropolitan areas.

1.3. Research questions

The research questions are the following:

1. What subsidies exist in the transport domain of Budapest metropolitan area? How do such subsidies influence inner city car domination?
2. How are inner city related mobility subsidies distributed among the inner city residents and workers? How just is this subsidy distribution considering the principles of what constitutes a just distribution?
3. What would be the design of a just redistributions of subsidies?
4. What are the public views about the current distribution of subsidies and about potential redistribution of parking subsidies?

1.4 Expected outcomes and contribution

As to the author's best knowledge, no former study has explored comprehensively the distribution of urban transport-related public costs as subsidies through the lens of distributive justice in Budapest, not least because public costs usually are not considered as subsidies. Therefore, exploring the distribution of widely interpreted subsidies can open the door to a completely new research area, and analysing its distributive justice aspects enrich the policy solutions available for reducing inner city car domination.

1.5 Limitations of the research

The most important limitations of the research are the following. First, it assesses the justness of the inner city mobility only from a distributive perspective and ignores the procedural and recognition perspectives[15]. Secondly, it assesses only the public views about potential subsidy reforms and ignores other pre-requisites of subsidy reforms, such as views of experts or political actors, supportive legal environments, etc. Thirdly, it ignores the issue of eco-gentrification that could entail the displacement of the less affluent population from the more attractive and more expensive gentrified inner cities. Fourthly, as exploring the public views regarding several potential subsidy redistributions was beyond the scope of the research, only the public views regarding potential parking subsidy redistributions are explored. Parking subsidies were selected, as in their cases subsidies are legally determined and they are assumed to be more easily perceivable than other subsidies. Though these issues were not analysed in detail in the dissertation, they were still addressed in the discussion chapter in a contemplative way.

[15] The procedural perspective focuses on the process and aims to provide equal opportunities to shape societal rules regarding the distribution of benefits and burdens. The recognition perspective focuses on recognizing the differences among social groups and their interests (see more details in the literature review).

A further limitation is the generalized estimations of subsidies. It could be argued that the individually received subsidies could be estimated more precisely, taking into accounts the environmental categories of cars or the exact location of parking spaces. The primary reason for this (over)generalization is that a generalised picture about subsidy distribution was sufficient for the purpose of the research that was to present the extent of distributive injustice rather than to describe it.

1.6 Structure of the dissertation

The dissertation is structured in 8 chapters.

Chapter 1 introduces the problematique, the research aims, the research context, the research objectives and the expected outcomes and contribution of the research.

Chapter 2 reviews the relevant literature and introduces the conceptual framework.

Chapter 3 introduces the case study area (Budapest), since it is essential to understand the subsequent analyses.

Chapter 4 presents the methodological aspects of the research.

Chapter 5 explores the transport-related subsidies in Budapest metropolitan area and the influence of transport-related subsidies on inner city car domination.

Chapter 6 explores the distribution of transport-related subsidies among different groups and how the distribution relates to distributive justice. Then it explores how a subsidy reform could look like in the case of different subsidies.

Chapter 7 explores the public views about the distribution of subsidies and the public support of potential subsidy reforms.

Chapter 8 discuss the insights of the analyses and contemplate on non-analysed issues that might hinder potential subsidy reforms.

Chapter 9 concludes with the results and formulates policy recommendations that can reduce inner city car domination by utilizing the endeavour for social justice.

2 LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Automobility and inner city car domination

To describe modern societies' complex relation to the car, automobility might be the most generally used term in the literature (Urry 2004, Hoffman et al 2017, Rérat 2018). The concept of automobility might best be grasped as a system that sustains itself by creating circumstances in which cars are necessary. That is, in terms of economy, automobility is the hub of an industrial complex that requires (and so makes huge efforts to generate) a need for cars for pursuing business. In terms of lifestyle, automobility "produces desires for flexibility that so far only the car is able to satisfy" (Urry 2004). In terms of land use, automobility contributes to unsustainable structures, such as extensive suburbs, single-use zones, fringe cities that can hardly be used without cars. In terms of safety, automobility creates spaces where cars are perceived as the only option to move safely, particularly in the case of children. Such self-sustaining mechanisms make automobility extremely stable and resistant to change. In short, through automobility "the car creates the preconditions for its own inevitability" (Zijlstra and Avelino 2011).

This research, however, focuses on the relation between the inner city and the car, where this relation is rather different as it is more physical and less inevitable. It is more physical, as unlike elsewhere, in most inner city outdoor spaces one cannot avoid the car as much of the outdoor space – parking spaces and most road surface - is devoted exclusively to cars, and the noise and air pollution of cars surrounds people even in places from where cars are banned. On the other hand, it is less inevitable, as in inner cities the alternatives of private car use are much more viable than elsewhere due to the high densities and short distances. In order to express these differences, this research uses the less frequently used 'car domination' term (see e.g. Massot and Armoogum 2003, Tiwari et al 2011) to refer to the cars' pervasive effect on the inner city, which was described in the introduction.

2.2 The drivers of inner city car domination

The negative aspects of inner city car domination have given rise to many alternative visions of inner cities where car domination is less intensive or even ceases. For example, Jacobs (1961) propagated the ‘attrition of automobiles’ by the city through reducing road capacities, widening sidewalks (up to a width of 10 m), increasing density and mixing land use. However, she still devoted a somewhat important role to conventional cars as she thought a certain level of car use is needed to avoid a city vacuum deserted by residents (Jacobs 1961). Sheller and Urry envisioned future cities where accessibility would be ensured by “slow-moving, semi-public micro-cars, bike lanes, pedestrians and improved mass transport” that “would restore some of the civility to urban public space” (2000). Kushner (2004) proposed the post-automobile city that is not car-free, but “redesigned to offer infrastructure for pedestrians and those who desire to live car-free”. Crawford (2000) went even further in his vision of car-free cities with conglomerates of walkable circular city districts connected by high-capacity and fast public transportation and where private car use is completely eliminated. And besides visions, inner city car domination was also indeed reduced in some places, for instance in the pedestrian zones of Copenhagen, Oxford or Groningen (Gemzoe 2001, Parkhurst 2003, Tsubohara 2007). However, these zones cover only small parts of the inner cities, and in the other parts, car domination persists.

If alternative visions exist, why does problematic car domination of inner cities prevail in so many cases? According to the utility theory of welfare economics car domination in inner cities is the consequence of people’s rational decisions about car use and subsequent parking. As it was described in the introduction, while the relative benefits of car use and parking are numerous and obvious, their primary cost – their price - is reduced substantially as a large part of their social costs are not borne by the car users (Maibach et al 2008). These unborne social costs are the external costs of car use and parking, and the subsidies car users receive in the form of discounted prices, tax abatements, etc. (Kageson 1994) and referred to as public costs in this research. The lack of payment for the public cost of car use then raises the demand for car driving and parking to a great extent and results in more intensive car use (Banister 1994). Moreover, this lack of payment for the public costs encourage urban sprawl and urban sprawl then encourages motorization and inner city car use (Dieleman & Wagner 2004, Gallez & Orfeuil 1998). As the lack of payment for public costs encourages inner city car domination, it is widely accepted that requesting car users to bear the public costs of their car use is an effective way to reduce urban car use and its negative side effects (Banister 1994, OECD 2005, Maibach et al. 2008).

Lack of payment for the public costs takes place not only in the case of car use, but in the case of public transportation, too. Besides governments spending enormous amounts on public transportation, particularly in the suburbs (Börjesson et al 2020), public transportation also entails external costs that the users do not cover. The effects of this lack of payment on car domination in the inner city are uncertain. On the one hand it is expected to encourage a shift from car use to public transportation and so to reduce inner city car use (Van Goeverden et al. 2006). On the other hand it – particularly in the case of suburban public transportation - encourages urban sprawl (Brueckner 2003), and as urban sprawl encourages inner city car use (see previous paragraph), it can contribute to inner city car domination[16].

2.3 Mobility subsidies

Generally, the term subsidy refer only to monetary public support – including discounted prices and tax abatements – provided for mobility users. This study, however, regards not only the monetary public supports, but also the external costs – that is all public costs - of mobility as subsidies for the following reasons. Most importantly, due to the ‘polluter pays’ and ‘user pays’ principles, polluters

[16]Certainly, there are several other drivers of urban sprawl, such as inadequate planning, subsidies for land consumption, etc. (Blais 2010, Colsaet et al 2018). And as urban sprawl encourages inner city car domination, these drivers indirectly contribute to inner city car domination. However, exploring these drivers is beyond the scope of this research. Therefore this research considers the transport cost reductions as the primary diver of inner city car domination.

and users should bear all the public costs of pollution and use. As society must bear the external costs anyway, any external cost is clearly "a cross subsidy between society and the polluting activity" (Valsecchi et al. 2009). Secondly, the right to an unpolluted environment in which personal or family life can be pursued without health harms is recognized in many constitutions, including that of Hungary and most other European countries (Nickel 1993). Valsecchi et al. (2009) have argued that that governments should be active to provide such an unpolluted environment, and if they neglect to do so, they should be responsible for the harms caused by pollution, similarly to criminal liability in case of negligence. Thus the governments' inaction actually is an action that confers favourable treatment on polluting transport, and as such, it can be argued that it meets the requirements of the widely used definition of subsidy: "a result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs" (OECD 2005), and so the external costs entailed by the inaction can be arguably regarded as subsidies (Valsecchi et al. 2009).

The most common counter-argument against considering environmental externalities as subsidies is the uncertainty that surrounds their quantification (OECD 2013, Valsecchi et al. 2009). Though such uncertainty admittedly exists regarding the monetary value of external costs, their existence is widely accepted, as it was presented above. Therefore, I argue that ignoring the value of external costs completely entails the same kind of scientific bias as their potential overestimation. In addition, though the quantification of some externalities are rather uncertain, e .g. cost of noise pollution, life quality reductions, other ones are based on scientific methods widely applied internationally. Accounting only for the externalities quantified by widely acknowledged international organizations, such as OECD, WHO, CE Delft, etc. can reduce the bias of overestimating externalities significantly.

But if it is widely accepted that the society cover the external costs of car use, why do not policymakers regard the external costs as subsidies, like e.g. in the domain of public transportation where subsidy is a commonly used term? First, not all policymakers do refuse to do so, for instance the IMF regard all external costs as subsidies, and as a result, it estimates the extent of global fossil energy subsidies as around ten times higher than other international organisations (Skovgaard 2017). Secondly, it might be only a question of time until external costs are considered as a subsidies as the definition of 'subsidy' has already gone through a profound transformation since it was initially used in economic studies. Initially, it referred only to the direct payment the supplier or consumer of a good or service received from the government, but later it was complemented by tax reductions or by uncollected fees that also originate directly from governments (OECD 2013). Next, price reductions due to regulated prices set below market prices were included among the list of subsidies (ibid.). The IMF's approach to subsidies might be the first sign of extending the term of subsidy to external costs. Thirdly, as Skovgaard (2017) suggests, referring to external cost simply as external cost or social marginal costs rather than as subsidy might be a political interest of certain decision-makers. For instance, at the international level using the subsidy term would imply that transport subsidy is not only a policy tool of developing countries often criticized by developed ones, but a tool used primarily by the most developed countries, thus contradicting the claims of developed countries that they do not subsidize fossil fuel (Skovgaard 2017).

This study insists on applying the 'subsidy' term to the external costs, too, for two reasons. First, I argue that external costs logically are subsidies based on the arguments presented above, and they might be referred to otherwise due to political interests. Secondly, this study explores the transport subsidies in the context of cost-related distributive justice, and using the 'subsidy' term makes the interpretation of distributions easier.

2.4 Distributive justice and mobility subsidies

The pursuit of a more just society has long been a major society-shaping force. The aims of this pursuit can be categorized fundamentally in two aspects of social justice: distributive and procedural justice (Pereira et al 2017, Törnblom and Vermunt 2007). Distributive justice focuses on the outcome and aims at a just distribution of benefits and burdens the society provides to or inflicts on its members. Procedural justice focuses on the process and aims to provide equal opportunities to shape societal rules regarding the distribution of benefits and burdens. In addition to these two fundamental aspects, other aspects have often been considered, too, that relate to the interplay between them (Törnblom and Vermunt 2007). One of these aspects is sometimes called interactional or interpersonal justice, particularly in the corporate sector, and can refer to the relationship between the allocator and recipients, to the style of communication regarding the distribution, to the intercultural differences in interpreting justice, etc. (Beugré and Baron 2011, Törnblom and Vermunt 2007). In addition, recognizing the differences among social groups and their interests is often regarded as a prerequisite of social justice (Schlosberg 2004). This research addresses only the distributive justice aspect of social justice, as the internalization of external costs can primarily be interpreted as a distributive justice issue. Certainly, other aspects of justice might have an important role in reducing inner city car domination too, but exploring those roles is beyond the scope of this research.

Inner city car domination related distributive injustice manifests in the context of urban injustice – a concept that entered the public domain almost 50 years ago following Harvey's (1973) book about the (un)just city. Since then, a good deal of research has explored the different aspects of urban justice, such as urban planning, accessibility of public space, and exposure to environmental problems (e. g. Fainstein 2014, Bodnar 2015, Haughton 1999). Their findings are relatively unambiguous: cities are unjust as different social groups benefit from the social goods and are exposed to social ills rather unequally.

Mobility-related distributive justice issues contribute to many aspects of urban injustice to a great extent, depending on the subject of distribution. Gössling (2016) explored the distribution of adverse outcomes of transport and identified three dimensions of them: exposure to burdens, space and time. The numerous burdens of transport include accidents risks, distress, air and noise pollution, to mention the most important ones, and their distributions are obviously unjust in most cases. For example, cyclists and pedestrians are exposed to higher accident risks than car users due to the larger mass and higher speed of cars (Jacobsen and Rutter 2012), and fear of accidents distresses cyclists much more than car users (Gössling 2016). Regarding air and noise pollution, people with a low income or disadvantageous minority backgrounds often reside in low-cost surroundings in the proximity of intense traffic activities and experience higher pollutions than others (Miranda et al 2011). Regarding space, cyclist infrastructure per user occupies much less public space than car infrastructure per user (Gössling 2016). And injustice also often manifests in traffic management prioritizing car diving over bike use (Tranter 2012), although modern transport planning usually strives for breaking such prioritization.

Pereira et al. (2017) identified rather different subjects of distribution: transport-related resources, observed daily travel behaviour that might reflect well-being of people and transport accessibility levels. Among these subjects, the distribution of accessibility has received far the most attention recently (Martens 2017, Pereira et al 2017, Verlinghieri & Schwanen 2020). The proponents of this approach argue that the distribution of accessibility to employment, education and service is uneven and unjust, and so policies should aim to provide equal accessibility (Guzman & Oviedo 2018, Deboosere & El-Geneidy 2018), or "a minimum level of access to those key activities that are essential for meeting basic needs" (Pereira et al. 2017). It must be noted that this approach is best used at the national or regional level where there are enormous differences in accessibility, for example between a city and a remote village. However, as inner city car domination is primarily affected by the city's metropolitan area, accessibility issues concerning inner city car domination have to be interpreted in this area where differences in accessibility are significantly smaller, and the minimum level of access is likely to be provided in most cases.

The rather diverse research about transport resource distributions reflect the various forms of resources used for transport systems. The uneven and potentially unjust distribution of private resources - cars, bicycles, etc. - (Ong 2002) is rather obvious. Other studies have demonstrated that the distributions of publicly supported transport infrastructure resources and public transport subsidies are also often uneven as transport users benefit rather differently from infrastructure projects and public transport subsidies (Khysti 1996, Fearnley 2006). And if parking places are regarded as resources, then their distribution provides another example for unjust distributions (Groote et al. 2015).

This research, however, focuses only on the distribution of the mobility subsidies that inner city residents and workers – the primary contributors to inner city car domination - receive. Most modern societies provide extraordinary subsidies for people, for example educational services, basic health services, state pensions, social aids, to name some of the most important ones. And most of the times, it is a basic expectation in these societies that the distribution of such benefits should be just. According to distributive justice theories, a distribution is considered just if it is based on desert (equity), need or equality (Deutsch 1985, Miller 1999). The relative importance of these three bases depends on the context or the aim of the benefit. For example, as the aim of public awards or scholarship is to reward and so encourage outstanding performance, its distribution should be based primarily on desert, as social aids aim to help the disadvantaged, their distribution should be primarily based on need, and as the most frequent aim of primary education is to provide equal opportunities, its distribution should be primarily based on equality (UNESCO 1960). Certainly, these considerations are not exclusive. For example, one might suggest that public awards should be distributed more widely (basis of equality), social aids should be distributed only among those who deserve it (basis of desert) or better education services should be provided either to the hard-working (basis of desert) or to the needy ones (basis of need). Another issue is the relative proportion of the three bases. Libertarian people might favour the more frequent use of the desert principle, as they believe in hard work being rewarded, egalitarians might prefer the more frequent use of the need or equality principle as they believe in equal opportunities (see for example Riberio (2014) in the case of basic education). However, if the distribution of social benefits is clearly not based on any of these principles, then most people are likely to consider it unjust (Miller 1999). As mobility is an everyday activity, the desert principle seems to be irrelevant in the distribution of mobility subsidies. Thus the distribution of mobility subsidies can be regarded just if it is based on need or equality.

Still, the distribution of mobility-related subsidies is clearly not always based on such grounds. For example, Coady et al (2015) found that in Nigeria a rather large share of conventional fuel subsidies goes to high-income groups simply because they consume much more fuel than low-income groups. Obviously, if the environmental external costs were included in the analysis, the difference between the amounts of subsidies the rich and the poor receive would be even higher, as the extent of external costs of fuel use is directly proportional to its consumption in most cases. Nevertheless, though this distribution is not based on any of the concepts just distribution can based on, the authors view it as a problem of aid effectiveness rather than a problem of justice. Similarly unjust distributions were demonstrated in many oil producing countries, e. g. in Iran (Magshoudi & Ardahaey 2012), in Saudi Arabia (Sarrakh et al 2020), in Ecuador (Schaffitzel 2011) or in Trinidad and Tobago (Scobie 2017).

Regarding developed countries, car driving normally is not considered as subsidized, as fuel prices reflect the international prices, and fuel is frequently taxed in order to provide funds for infrastructure creation or maintenance. Due to ignoring external costs as subsidies, external cost related subsidy distributions are not investigated. However, as the unpaid external costs are proportional to the fuel expenditure or emissions of car driving to some extent, the distributions of these variables can serve as a proxy to the subsidy distribution. And these distributions are often not based on any of the concepts just distributions can be based on. For example, Banister (1994) found a highly unequal distribution in car use expenditure, the highest income group spending 45 times so much on car use than the lowest income group. Regarding emissions, Brand and Boardman (2008) revealed an extremely unequal distribution of greenhouse gas emissions in the United Kingdom: according to their findings, "the top 10% of emitters are responsible for 43% of emissions and the bottom 10% for only 1%". As the highest income group contributed to much more emissions than the lowest, this inequality in GHG emissions suggests a rather unjust subsidy distribution.

On the other hand, the car parking and public transportation subsidies are directly acknowledged in the developed countries. For instance, Groote et al (2015) found that in Amsterdam, the rich households are five times more likely to receive parking subsidies than the poor ones. And though public transportation subsidies are expected to benefit the lower-income group, the distributions of such subsidies varies a lot - being progressive in some cases and regressive in others – when the whole public transportation network is considered being subsidized to the same extent, regardless of the actual costs of different routes (Fearnley 2006). In a different approach, Börjesson et al (2020) calculated the actual subsidy rate for each route and for different types of people – that is, they calculated higher subsidy rate in routes on which occupancy rate and so theoretical ticket revenue is lower, and they took into account the student and retired discounts -, and found only a mildly progressive distribution of subsidies.

It must be noted that most studies addressing transport subsidies assume that if the distribution is progressive then it is just, for it entails that the distribution is based on need. Nevertheless, I argue that progressivity of subsidy distribution alone is not a sufficient criterion of just distributions based on need, as a need-based distribution entails that all people with similar needs receive a similar amount of subsidies, and people with higher needs always receive more subsidies than people with lower needs. As a progressive subsidy distribution means only that the average subsidy a low-income person receives is higher than the average subsidy a high-income person receives, it does not meet these criteria. For instance, Börjesson et al. (2020) found that the place of residence explains the variation in subsidies much more than income, as the further somebody resides from the centre, the more subsidies she or he receives. Therefore, on the one hand, two persons of the same income group, who lives at a different distance from the centre, can receive radically different subsidies, while on the other hand, a high-income person living far from the centre receive much more subsidies than a low-income person residing in the proximity of the centre.

It can be argued that income is not the only factor that influences the need of a person. For instance, a person with medium income who live far from his workplace might be be considered to need mobility subsidy. However, the overwhelming majority of people with medium or high income are likely to select their place of residence or/and workplace voluntarily to some extent[17]. In this regard, income is yet the most important factor in determining the extent of need. Certainly, the mobility needs of disabled people is another issue as they can be regarded as people with need regardless of their income. Nevertheless, the analysis of disabled people's mobility is beyond the scope of this dissertation.

2.5 Subsidy reforms based on distributive justice

Subsidy reform ideas arguing for more just distributions of mobility-related subsidies are rather common in the developing world, though they are rarely implemented comprehensively (Schaffitzel 2011, Guillaume et al. 2011, Sarrakh et al. 2020). The most extensive subsidy reform that pronouncedly aimed at a more just distribution occurred in Iran in 2010 (Guillaume et al. 2011). Before the reform, the distribution was extremely unjust, as the richest deciles of households received 12 times more fuel subsidies than the poorest deciles (Magshoudi & Ardahaey 2012). Due to the reform, the extremely low gasoline prices (approximately 0,075 EUR/l) quadrupled, and more

[17] Certainly, family ties or other factors might determine the place of residence or/and workplace, too, but there are more important public aims than facilitating relatives to live or work in the proximity of each others.

than 90% of the population started to receive the same allowance of around 3 EUR/month (the remaining 10% did not require the transfer, many of them presumably due to its low amount compared to their revenues). As an effect of the widely supported reform, the annual gasoline consumption was reduced by almost 20% (Guillaume et al 2011).

Similar policies that increase fuel price and distribute the revenues among people are contextualized in a completely different way in developed countries. They are named revenue recycling or revenue neutrality, and they aim to garner public support and/or to increase economic efficiency by replacing labour taxes by green taxes rather than increase fairness (Beiser-McGrath & Bernauer 2019, McKenzie 2016). Thus, revenues are usually neutralized by applying lower tax rates that usually benefit the high-income people more, i.e. distributive justice principles usually play a minimal role. One exemption is the scheme implemented in four Canadian provinces, in which all households of the provinces receive a dividend payment the amount of which depends on the size and composition of the household, and is 10% higher if the households resides in the countryside (Wood 2021). Moreover, the influential Agora Energiewende and Agora Verkehrswende (2019) study proposed a 50 EUR/t carbon tax on fuel and natural gas to internalize the external costs of CO_2 emissions and an equal distribution of revenues in Germany, but the proposal was not implemented. Nevertheless, these policies target carbon emissions in general and relates to mobility only because mobility relies primarily on fossil fuel.

To the author's best knowledge, no similar policy was implemented specifically in the context of urban mobility and no study has examined the possibility of such a policy through the lens of distributive justice; not least because external costs usually are not regarded as subsidies and in that case there is not much to redistribute. Though Banister (1994) considered the redistribution of the revenue from internalized external costs, he assumed that it is complicated and that public support for such redistribution is weak and/or uncertain. Nevertheless, public support for equal or need-based monetary distribution of revenues, which would be similar to the Iranian reform, has not been investigated.

Certainly, it can be argued that car use in Iran is likely to be more uneven than car use in developed countries. The redistribution of car use related subsidies in Iran benefits and satisfies more people and to a greater extent than in the developed countries. However, I argue that regarding car use, inner cities are likely to be much more uneven places than other parts of developed countries as the modal share of car use is lower in inner cities than elsewhere (Jarass and Heinrichs 2014). Therefore it can be assumed that a subsidy reform aiming at a more just distribution of widely interpreted subsidies in inner cities could enjoy greater public support than elsewhere. Thus a research exploring the current subsidy distribution of inner city car domination and the public views about a more just redistribution of subsidies is likely to provide new insights in the field of environmental policy.

2.6 Mobility-related subsidies in Budapest

As one full chapter of the dissertation explore Budapest thoroughly, the primary aim of this section is to locate Budapest in a European context. Compared with other major European cities Budapest performs relatively well in many variables related to sustainability as presented in Table 1.

Table 1. Sustainable indexes of Budapest and other European capitals. Data source: European Union 2016.

	Budapest	European capitals (range)	Budapest's rank
Number of passenger cars per thousand inhabitants	325	240 -700	8. (out of 22)
Respondents who most use cars as a mode of transport	15%	8 – 75%	8. (out of 31)
Respondents who most often use public transport as a mode of transport	66%	6 – 73%	5. (out of 31)
Respondents who most often use cycling as a mode of transport	9%	1 – 59%	14. (out of 31)

Regarding air pollution, however, Budapest is performing much worse and so the per capita cost of air pollution is 46% higher than the average value of 432 European cities. This is probably partly due to the low environmental standards of many cars compared to Western European cities. These comparisons suggest that the mobility-related subsidies are likely to be higher than the average and the distribution of them is likely to be more unequal in Budapest than in most other cities, since in Budapest relatively fewer car users are likely contribute to probably higher public costs than elsewhere. Therefore, Budapest is particularly suitable for exploring the unjustness of mobility-related subsidies.

Distribution of mobility-related subsidies (or public costs) was not estimated comprehensively in Budapest so far. Regarding the extent of public costs, Pal (2006) explored the mobility-related external costs of urban sprawl in Hungary and suggested a lump-sum value 980 EUR/year/household in the case of suburban households outside Budapest. Juhasz (2010) estimated that in Budapest 54% of the social costs of mobility are not covered by the mobility users. Other studies (Paldy and Bovbos 2012, Bruyn & de Vries 2020) are comparative studies and focus only certain elements of the external costs. Moreover, none of these studies aspire to explore the distribution of mobility-related subsidies i.e. the distribution of the contribution of different groups or persons to the public costs of mobility.

2.7 Conceptual framework

The conceptual framework of the research is based on the following considerations. First, it considers inner city car domination as the consequence of many individuals' rational decisions. Secondly, it acknowledges that these decisions are primarily influenced by the current practice, according to which in many cases transport users pay only a part of the costs related to their transport. Thirdly, it considers the public costs of transport as subsidies. Fourthly, it regards the distribution of subsidies just if it is based on need or equality and regards it as unjust if it is not based on any of these grounds. Fifthly, it considers supportive public views as a pre-requisite of any major policy change.

Based on these considerations, the research explores transport subsidies in relation to inner city car domination and their distribution. Then it explores how the subsidies could be distributed in a more just way. Finally, it explores the public views about the current distribution and potential redistributions.

The research acknowledges that a major policy change requires other factors besides public support. Though the proper exploration of such factors is beyond the scope of this research, they are briefly addressed.

3 Methodology

The primary aim of the research is to explore the potential of just distribution of mobility-related subsidies to reduce inner city car domination.

3.1 Case study approach

The research was performed through a case study design with one case being explored for the following reasons. First, as the subsidies and their distribution are likely to be different in each city, it would be rather complicated to explore these at a general level. Secondly, the quantification of subsidies required a significant amount of research time per case, as subsidies are numerous and their calculation requires plenty of not easily acceccible data. Thus, due to the limited time frame of the research a sufficiently detailed analysis was possible only in one case. Cetainly, a single-case study potentially limits the generalization of the findings, but a less detailed analysis of subsidy distribution would jeopardize the credibility of the findings.

Budapest was selected as the case study, as being the researcher's place of residence for the last 25 years), it is where the researcher has substantial knowledge about mobility and land-use issues and is familiar with the stakeholders' network, which made the data collection easier. In addition, the relatively low car ownership rate made Budapest a particularly good case, as mentioned above.

3.2 Description of Budapest metropolitan area

The exploration of mobility-related subsidies in Budapest requires comprehensive information about Budapest metropolitan area. Therefore, in Chapter 4 I describe Budapest urban structure, the mobility patterns of its residents, the mobility infrastructure and services and the individual monetary costs of mobility and demarcate the inner city. Most of this description is based on presenting various statistical data. One exemption is the description of mobility patterns of commuting trips that is based on differentiating commuting trips according to their direction and lengths and estimating their volumes and modal splits. The insight gained by applying this method was used to identify groups of people with similar mobility patterns, and estimate some mobility indexes of the average group individuals of different groups in the case of the analysis of mobility-related subsidies (see 3.4.4. section). However, for the sake of easier understanding this method is presented along the estimations in Chapter 4.

3.3 Methodology overview

In order to explore the potential role of the endeavour for just distribution of mobility-related subsidies in reducing inner city car domination I needed to assess the justness of the distribution of such subsidies. Assessing the justness of the distribution required me to explore how much subsidies different individuals receive and determine whether the differences in received subsidies can be justified by any concept of distributive justice. As data about subsidies individuals receive were not available, I have identified groups, in which individuals are likely to have similar mobility patterns, estimated average mobility indicators for individuals within different group representing different mobility patterns, as well as the amount of subsidies they receive. Such estimation required me to assess the average subsidies per use for each mobility activities, so afterwards, based on the mobility patterns, I could estimate the full amount of subsidies the average individuals of the groups received. Then I compared these amounts of subsidies to each other and scrutinized whether any differences among them was based on need. As I found that the distribution of mobility-related subsidies was unjust, I explored how the subsidies could be redistributed in a more just way. And in order to explore the public views about the justness of current distributions and the public support of certain redistributions, I surveyed these views through questionnaire surveys.

3.3 Assessing mobility-related public subsidies

Mobility-related public subsidy is defined as individual monetary costs of mobility that are not covered by mobility users or other private entities and the external costs of mobility. Thus subsidies include external costs, tax exemptions, subsidized prices (when prices are lower than the monetary cost of providing the service, or the price others pay for the similar service) and direct monetary subsidies. As the ultimate aim of subsidy assessment was to compare mobility subsidies the averaged individuals of different groups receive, it was necessary to calculate the unit cost of each subsidy, so the aggregated subsidies that the average individuals with different patterns of mobility receive can be compared. Therefore in the case of external costs, the assessment was based on the methodology applied by Gössling et al. (2019) in which unit costs were calculated that represent generalised values per passenger kilometre (pkm) regardless of any other factor such, as the type of the car, the location, etc. These unit costs were calculated primarily by dividing the total external costs caused by a certain mode of transport with the total pkm of that mode. In the case of parameters that are unspecific to cities - that is the cost is independent of the location, like in the case of the costs of climate change -, I used the values calculated by the study of Gössling et al. (2019). In the case of parameters that are specific to cities – that is the unit cost is different from the globally averaged value, like in the case of air pollution – I calculated the unit external cost through dividing the total external costs caused by certain mode of transport in Budapest metropolitan area by the total pkm of the certain mode. These specific calculation methods are presented in detail below.

In the case of subsidies other than externalities, I have aspired to calculate unit costs per pkm, too, except in the case of residential parking subsidies, as parking is completely unrelated to the pkm performed by the car. Therefore, in the case of parking subsidies, annual values were calculated. As the assessment of the distribution of subsidies based on comparing the subsidies different groups received annually, the pkm unit subsidies and annual parking subsidies could be aggregated (see details below).

In case of cycling, I considered the subsidies (i.e. the public costs) as zero for the following reasons. First, according to Gössling et al. (2019) the actual external costs of cycling or walking is minimal, and their external benefits offset the external costs several times; thus, the external costs of cycling and walking are -0.184 EUR/km and -0.370 EUR/km, respectively. Besides external costs the main elements of cycling's public costs are the costs of infrastructure that are usually not covered by cyclists. However, from the one hand it can be assumed that such infrastructure costs are minimal, at least compared to car use and public transportation[18]. On the other hand, it can be debated whether cycling infrastructure costs should be attributed completely to cycling, as cyclists could readily use the same infrastructure, as cars, were car use slower, safer, and less polluting. In this sense, cycling infrastructure can be considered as infrastructure that allows quicker and more polluting car use and so part of the costs of cycling infrastructure might be considered as the unpaid private costs of car use. Further public costs includes direct monetary subsidies provide by some municipality, the subsidized use of community bikes and the subsidized provided for acquiring e-bikes. However, the amount of these subsidies is small and very few people receives them[19]. Therefore, it was considered that the negative external costs offset these subsidies completely.

3.3.1 Subsidies related to the generic external costs of motorized transport

Generic external costs refer to external costs that are similar regardless of the location of car use and so differentiates from location-dependant external costs. These generic external costs include the external costs of climate change, external costs of soil and water quality reduction, land-use and infrastructure, traffic infrastructure maintenance, resource consumption and accidents. In addition,

[18] The costs of cycling infrastructure developments are distibuted among the state and the municipalities of Budapest and the districts and so information about them are hardly available.

[19] It must be noted that the subsidies for acquring e-cars were not quantified either in the study.

the external costs of noise pollution were considered as generic costs, as the discussion on its extent in urban environment is unsettled. In the case of car use, the values estimated by Gössling et al. (2019) are used[20]. In public transportation, the unit cost per pkm was estimated to be the third of the pkm value of car use based on the 'Handbook of the external costs of transport' by van Essen et al. (2019).

3.3.2 Subsidies related to health costs of air pollution

As air pollution related unit health costs are much higher in cities than in rural areas due to the concentrated emissions of pollutants in a densely populated area, they were estimated separately from the generic external costs. The unit costs of air pollution were calculated similarly to the methods applied by Gössling et al. (2019) and van Essen et al. (2019) that is health costs caused by car and bus traffic were divided by the pkm volume of car and bus traffic, respectively[21]. As the health costs caused by car and bus traffic were not available, for this calculation I determined the overall costs of air pollution in Budapest (*overall costs*), the total contribution of car and bus traffic to air pollution (*contribution*) and the pkm volume of car and bus traffic (*volume*), and then the per-passenger km costs can be calculated through the *costs*contribution/volume* formula. Though it can be assumed that the air pollution related external unit costs of car and bus traffic are higher in the traffic-loaded and densely populated inner city than in the outer parts of Budapest, due to the lack of data regarding the different part of Budapest I considered these external unit costs the same throughout Budapest, and I considered them zero outside Budapest. The estimation of overall costs

[20] The car use related external cost estimation of Gössling et al. (2019) is rather similar to the estimations of van Essen et al. (2019), except in the case of congestion and accident. As in these cases Gössling et al. estimates substantially lower values than the study of van Essen et al., using the estimations of Gössling et al. helps to avoid overestimating the external costs. In addition, I argue that the costs of congestion might be considered as covered since they are caused and borne by the same car users (it other words car users in congestion cover these direct costs with their time and money) (Korzhenevych et al. 2014). Certainly, public transportation users also lose time on buses or on trolleybuses stuck in the traffic, but as most of the public transportation in the congestion-hit inner city takes place on metros, trams or in bus lanes that are rather insensitive to traffic-jams, these time losses are considered negligible in this study. In addition, it can be argued that the time and monetary losses spill over to the economy and result in a lower economic output. Nevertheless, the quantification of such losses is rather uncertain.

was based on widely publicized data determined in a research commissioned by a coalition of public interest NGOs from 10 European countries, but also confirmed by other international research data (see details in section 5.1.2). The aggregated contribution of car and bus traffic to the overall external costs were estimated based on insights from academic researches. The volumes of annual car and bus pkm volumes in Budapest were estimated on the basis of statistical reports (KSH 2017) and mobility studies (Stratégiai Konzorcium 2013, Városkutatás Kft. 2009). Finally, by using the data gained in the previous steps, the external pkm costs were calculated for car and bus use[22], respectively.

3.3.3 Parking subsidies

As residential parking is either free or discounted in many inner cities across Europe (Kodransky and Hermann 2011), car parking receives substantial subsidies. In order to calculate these subsidies, the value of outdoor public space had to be determined. Outdoor public space is highly demanded in inner cities, because most people like to spend time outdoors in good weather, and as the inner city private outdoor space is rather limited, people are under the necessity of spending their outdoor time in public outdoor spaces. However, in the inner cities the per capita public outdoor space is extremely low due to the high population density and continuous development. In Budapest's inner city the per capita outdoor space is likely to be around 50 sq metres[23], but in the densest 7th district it is about 8-10 sq metres (based on estimated data from the municipality of the 7th district). This context of high demand and low supply suggests a rather high value of public space in inner cities.

However, outdoor public space has a peculiarity that makes the determination of its value rather difficult. From an economic point of view, inner city public outdoor space can take different

[21]As the trams, metros, local trains and trolleybuses run on electricity, they do not emit PM 2,5. Therefore their contribution to PM 2,5 pollution was considered negligible.

[22]In order to simplify the calculations, it was considered as if each car and each bus emits the same amount of $PM_{2.5}$ per km, respectively, regardless their type, the age, the speed, etc.

forms, such as non-vehicular public space (pavements, parks, pedestrian zones), semi-privatized non-vehicular space (such as terraces of restaurants), parking space, vehicular movement space (such as roads, tramways, bike paths), etc., the extents of which are not necessarily constant. Due to these difficulties, the value of public outdoor space cannot be determined by methods based on the willingness to pay concept or on the relation of demand and supply, as probably people are willing to pay differently in the case of different forms, and the supply depends on many different factors. In addition, the value of outdoor public space depends on the quality of the public space and the personal needs of the inner city residents, too. Therefore, for lack of anything better, this study relied on the existing prices of outdoor space use as clues to determine its value. Certainly, this way of determining the value of public outdoor space has limitations. For example, if the price of residential parking would be as expensive as current non-residential parking, probably far fewer residents would park in public parking space, and so more parking space would be available for non-residential parking that would entail lower parking fees. From another point of view, one could argue that part of currently available parking space could be transformed to other kind of outdoor public space and so then the price of parking could remain the same. Similar line of thought could be applied for terraces. Currently, the extent of public outdoor space available for terraces – and so the price of this type of public space - is significantly influenced by regulation regarding pavements and parking space. If those regulations were modified, the extent of public outdoor space available for terraces could either increase or decrease, which would entail a change in the potential market price of terraces, too.

In order to estimate the value of public place in the inner city, first, the annual prices of 10 square meters (the typical size of a parking space) public space were calculated by using the official fees of different public space uses - such as terrace of catering facilities, parking of non-residents –

[23] Assuming that the area of the inner city is around 45-50 sq km, the inner city population is about 360-380,000 thousands people, and the 35-40% of the area is outdoor.

in different parts of the inner city of Budapest. Then the mean of the lowest[24] fee of terraces and the lowest parking fees for non-residents are considered as the annual cost of a 10 sq metre public outdoor space. Lowest values were applied to avoid potential overestimation, the mean value of the two functional use values were applied in order to avoid the peculiar effect of certain functions, and a single value for the whole inner city was applied in order to simplify calculations. In the case of public transportation, vehicles require much less parking due to their more intensive use in traffic, and as much of their long-term parking takes place outside the inner city (e.g. overnight), while in the case of cycling, bikes are typically parked less often in public space, and even then they require much less space. Therefore the costs of parking space consumption by bike and public transportation users were considered negligible.

It must be noted that in many cases parking requires much more public space than the parking space itself, because cars need to approach and leave the parking places through public road space. Certainly, it can be argued that road space is also used by through traffic and so it would be unfair to attribute that space entirely to parking. On the other hand, in most inner cities, there are many low traffic street sections that could be transformed into pedestrian or pedestrian-friendly zones without generating much city-level traffic disturbance, as is suggested by the superblock project in Barcelona - a city similar to Budapest in size of the population – in which the only vehicular function of around two-third of the inner city road surface will be allowing vehicles to access the parking spaces along the roads (Mueller et al. 2020). And a similar assumption can be deduced for the traffic calming project of the 7th district of Budapest that, though it has reduced through traffic drastically in the calmed area, still requires the same extent of road space in many cases (based on my experience). Thus, it can be argued that many sections of the road space in local streets primarily serve the parking on public or private parking places that suggest that their costs should be attributed to parking. Nevertheless, as the determination of actual road space requirements

[24] Closer a terrace or a parking place to the city center are, the higher their fees.

of parking was beyond the scope of this study, only the parking space was considered as the public space requirement of parking.

In addition, it could be argued that the proper accessibility of the inner city could be provided by smaller road space, for instance by one-lane roads instead of multi-lane roads or by lower speed limits that require narrower lanes. Based on this argument, it could be suggested that the extra road space serves the convenience and higher speed of mobility, rather than the accessibility, and so its free use is a subsidy for mobility users. Nevertheless, as the determination of such extra road space requirements of mobility was beyond the scope of this study, providing such extra space was not considered as a subsidy.

3.3.4 Public transportation subsidies

It is generally known that public transportation infrastructure and operation are subsidized directly from state or local budget[25] (Börjesson et al. 2020). In the case of Budapest, the annual full costs related to public transportation was estimated by overviewing financial reports of the public transportation provider and assessing the amount of annual spending on public transportation infrastructure (that is not part of the public transportation provider's budget). Overall subsidies were calculated by deducting the amount of annual ticket revenue from the annual full costs. The pkm unit subsidy of public transportation then was calculated by dividing the overall subsidies by the pkm volume of public transportation in Budapest. Regarding public transportation in the surroundings of Budapest, data about subsidies were not available and their estimations were beyond the scope of this research.

[25] It could be claimed that car infrastructure is also subsidized. However, car user cover partly the infrastructure costs through the levy (around 0.05 EUR/km) included in the price of the petrol. In an urban environment where roads are used intensively by cars, it is likely that road infrastructure costs are covered to a greater extent than in the countryside.

3.3.5 Commuting subsidies

In Hungary, employers are obliged to provide commuting subsidies to employees who work in a settlement other than their place of residence. By default, only public transportation subsidies are available, but if public transportation is cumbersome between the place of residence and workplace or the employee has a child who is under ten and attends child care or education institutions, then car use subsidies are also available (Personal Income Tax Statute 1995, 25. §, Government Decree 39/2010, 4. §). However, based on personal reports of my acquaintances, these conditions are rarely checked properly, and car use subsidies are commonly provided to anybody who commutes from another settlement and requests car use subsidy.

Commuting subsidies are public subsidies primarily because they are tax free up to the 100% of the interurban travel expenses in the case of public transportation, and up to 0.05 EUR/km in the case of car use. This tax exemption means that employers and employees do not have to pay the taxes that otherwise would be equivalent to around 98% of the commuting subsidy (24.hu 2015). In addition, subsidies provided by private entities obligatory due to regulation can be considered as public subsidies, as it raises companies' costs and so the prices of their goods and/or services and in this way commuting subsidies are partly paid by the society. Nevertheless, as the quantifiable translation of private subsidies into public subsidies is not straightforward, in this study only the tax exemption is considered as a public subsidy.

In the case of public transportation, the subsidy must cover at least 86% of the interurban travel costs, and at least 60% of the 0.048 EUR/km commuting subsidies that is the maximum level that can be provided in the case of car use. From an employers' point of view, employers from the one hand have an interest to provide as much transportation subsidies as possible, as it is tax-free, and so it entails less cost than providing a net salary increase equivalent to the commuting subsidy. On the other hand, salaries in most positions are determined by factors other than the place of residence, particularly in the case of the public, and commuting subsidies are regarded as extra costs above fixed salaries rather than salary substitutions. This means that the whole amount of commuting subsidies counts as an extra cost, and so employers have an interest to provide only what is obligatory – that is 86% of the interurban travel costs in the case of public transportation and 0.028 EUR/km in the case of car use. And it also means that commuters from other settlements have a competitive disadvantage in the labour market compared to local commuters, but as commuting subsidies are small compared to labour costs and in Budapest labour shortage is rather typical, this disadvantage is unlikely to play a significant role in recruitment. Therefore the 98% of obligatory provided commuting subsidies are considered as public commuting subsidies in this study.

It must be noted that commuting can be subsidized by providing free or discounted parking for employees, too. Legally, such provisions are considered as income of the car users which should be subject to taxes associated with the salary of the employee. However, it can be assumed that this is not always the case. In addition, in some cases, municipalities provide free or discounted parking instead of the employers. For example, the municipality of 7th district of Budapest provide free parking on public parking space for employees of companies that pursue an activity in the public interest in the district (Municipal Degree 59/2013). Another way of subsidizing commuting is the provision of company cars, as the use of company cars for private purposes allows the avoidance of income or dividend tax. When a company car is used for private purposes i.e. the company covers all the expenses associated with the private car use (acquisition, lease or rent fees, maintenance costs, fuel costs, etc.), these expenses are considered as income of the car users which should be subject to taxes associated with such an income, similarly to the dividend of the shareholder or to the salary of the employee. However, the avoidance of these taxes is rather common in Hungary and so companies use covering the cost of private car use as a tax-free income supplement (KTI 2010). Commuting by car is considered as private use as the work of an employee rarely requires using the car for commuting (exceptions include cases when e.g. the employee is in an on-call position that might require the immediate use of the car). The taxes associated with the net dividend or income are equal to the 67% or 98% of the net dividend or the income, respectively (KTI 2010, 24.hu 2015). As the full individual monetary cost of car use is around 0.25 EUR/km on average (totalcar.hu 2014), the avoided taxes are 0.17 EUR/km in the case of shareholders and 0.24 EUR/km in the case of employees. However, as the quantification of these subsidies was beyond the scope of this study, they were ignored.

3.3.6 General considerations regarding cost calculations

Costs were calculated in EUR throughout the dissertation to enhance the interpretability of readers who are not acquainted with HUF, the Hungarian currency. The applied exchange rate is 1 EUR = 314 HUF that was the official rate on the 22nd of July, 2016 (Central Bank, www.mnb.hu, 2016).

It must be emphasized that the method presented above was not designed to calculate the exact subsidies associated with urban mobility in Budapest's inner city. The aim was rather to demonstrate convincingly the significant extent of subsidies in the full costs of Budapest's mobility. Therefore only widely accepted research data and costs determined by legal sources were used in the analysis; and those types of costs that are highly contested and/or have received limited attention so far were excluded from the analysis. In addition, it must also be noted that at an individual level the costs of a person's mobility can be rather different from that of an average person behaving similarly. For example, an old diesel car is likely to contribute to air polluting emissions to a rather great extent, while a hybrid car is likely to contribute to it to a rather low extent.

3.4 Assessing subsidy distribution

The primary aim of this method is to explore whether the distribution of mobility-related public subsidies is just. As it was presented in the literature review chapter, the distribution of mobility-related subsidies can be considered just, if it is based on need or equality (desert was excluded as a a potential basis of distribution of mobility-related subsidies). Therefore first, I explored whether the distribution of mobility-related subsidies was equal (see details below). As I found that the distribution is rather unequal, I explored whether people who receive more subsidies have greater needs than people who receive less subsidies. As it was presented in the conceptual framework, I do not consider the progressivity of the distribution as a sufficient condition for being based on need, as a progressive distribution still can entail that people with similar extents of need receive different amount of subsidies. Therefore, I consider just the distribution based on need only if most people with greater needs receive more subsidies than others.

There are several methods to quantify inequality of distributions (Inoue et al. 2015), the Gini-coefficient being probably the most well-known one. However, most of such methods require at least estimated information about the economic factor (income, wealth, subsidy, etc.) being distributed for each individual. As such data about subsidies were not available, and their estimation was beyond the scope of this research, the application of these explicit methods were rejected. Instead, the method used in this research was based on identifying groups within which the mobility patterns of individuals are similar, but markedly different from the mobility patterns of individuals in other groups. I aspired to identify groups that consist of many people and covers the large part of population who reside and/or work in the inner city. Examples of groups include inner city residents who have cars but commutes to work by public transportation to their inner city workplaces, or suburban commuters who commute by car to the inner city, etc. Then the mobility-related subsidies the average members of these groups received were quantified for a year and compared to each other. As the aim was not to determine the exact extent of the inequality that e.g. then could be compared to other inequalities, but rather to demonstrate whether there is a significant inequality, this simple method was sufficient. Then I explored whether those groups the average members of whom receive more subsidies have lower income – as a proxy for need - than those groups the average member of whom receive less subsidy. Per capita household income was used as the only determinants of need, as the location of the place of residence is likely to be voluntarily chosen by most people in the Budapest metropolitan area, as it was suggested above.

3.5 The questionnaire surveys

The primary aim of the questionnaire surveys was to explore the public views about current distributions of some of the mobility-related subsidies and about their potential subsidy redistributions. And a further objective was to provide data for identifying groups with similar mobility patterns in the case of subsidy distribution analysis.

Three questionnaire surveys were analysed in the study. The first questionnaire survey aimed to explore the perceptions of inner city residents and commuters in relation to the inequalities in public space use and in contributions to the external costs of car use. Responses were collected between 3rd of February and 30th of May 2016. The methods of collecting responses were designed in a way to achieve as representative a sample as possible with a rather limited budget. The high number of responses was ensured by (1) online questionnaire forms, which were disseminated through Facebook advertisements, (2) a call by a popular blog focusing on urban issues, (3) an article about the survey in a district magazine. In addition, (4) around 3,000 leaflets about the online questionnaire were disseminated into mailboxes all over the inner city of Budapest that generated about 60 responses. These four data collection methods provided about 50%, 20% and 17% and 5% of all responses, respectively. As people with lower education and low income were significantly underrepresented in the sample, further responses (altogether 90 that is around 8% of all the responses) on paper forms were collected by visiting households or approaching locals in public spaces in deprived areas of Budapest, where the possibility of surveying people with low education or income was higher than in other areas. Finally, altogether 1122 people responded to the questionnaire, 822 and 308 of whom were inner city residents and commuters, respectively. As the questionnaires were slightly adjusted to the target group, for example the blog readers were directed to a questionnaire which contained only the more important questions in order to encourage a higher response rate, the sample size was smaller in some cases. Therefore the sample size will be always marked when results are presented.

The second and third questionnaires aimed to survey public views regarding parking subsidies. I performed these surveys during my work in the municipality of the 7th district of Budapest, but the results presented in this research have not been published so far. Due to this relation to the municipality, the surveys were targeted only at the population of the district. The primary aim of the second questionnaire was to survey the public perceptions regarding the preferred public space use, the current subsidies and a potential subsidy reform. Responses were collected between 3rd of April and 6th of May 2020. The high number of responses was ensured by an online questionnaire form disseminated through Facebook advertisements and by emails sent by the house management companies to the residents of the houses they manage. Altogether 907 responses were collected, 54 of which were from residents of other districts, who therefore were excluded from the analysis.

The primary aim of the third questionnaire was to survey the public perceptions regarding the justifications of current parking subsidies. Responses were collected between 24th of October and 10th of November 2020. The high number of responses was ensured by an online questionnaire form disseminated through Facebook advertisements and by emails sent by the house management companies to the residents of the houses they manage. 1020 responses were collected altogether, 127 of which were from residents of other districts, who therefore were excluded from the analysis.

The samples surveyed by the questionnaires do not represent the target populations perfectly. Due to the aforementioned collection methods, people who do not use the internet, who use Facebook rarely or do not use it at all, who are not interested in urban issues, are significantly underrepresented in the sample, and the relatively small numbers of respondents who filled in the paper form cannot compensate such a significant underrepresentation. Though there is no obvious reason to assume that the use of internet and Facebook or an interest in urban issues significantly influence opinions, such features are likely to entail the overrepresentation of younger generations and people with higher education level who are likely to use the internet and Facebook more frequently and/or to be more interested in urban issues. As these demographic features might influence opinion, the representations of different age cohorts and people with different education level were explored in the case of inner city residents where such distributions of these features could be estimated[26]. In case of the first questionnaire, the 26-35 years old age group was somewhat overrepresented, and the over 65 years old population was somewhat underrepresented in the sample compared to the Budapest population[27] (Figure 2.). Regarding the level of education, the differences between the sample and population are substantially larger (Figure 3.), the highly educated people are significantly overrepresented, while the undereducated people are significantly underrepresented[28]. Therefore, when it was relevant, I explored whether the distributions were different in the case of different age groups and in groups with different education level.

[26] The distributions of gender, age and level of education are rather unknown in the case of commuters, particularly as the category of Budapest inner city is not used in the official statistical surveys. Though these distributions are also unknown in the case of inner city residents, they can be estimated from the census data of Budapest and inner districts.

[27] The average age and the ratio of different age groups in Budapest inner districts are characterized with average values among the all districts of Budapest (Budapest Mayor’s Office 2011) therefore the age distribution of Budapest were used as a proxy of the age distribution of the inner city population.

[28] Though the rate of highly educated people is 3-4% higher in the inner district of Budapest compared to the whole population of Budapest, their overrepresentation is still very significant.

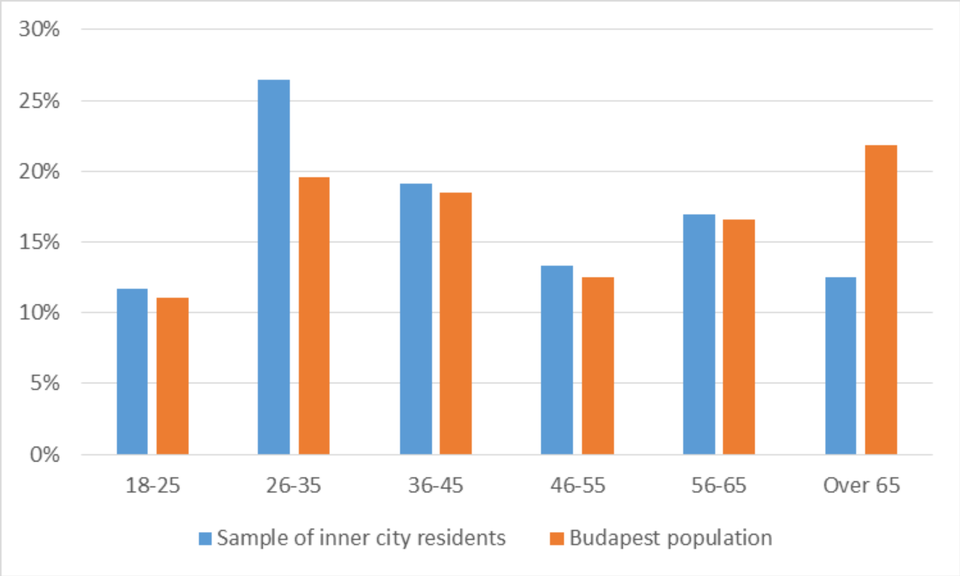


Figure 2. Age distribution of the inner city respondents and Budapest inhabitants who are over 18. Data source of the latter: KSH 2013

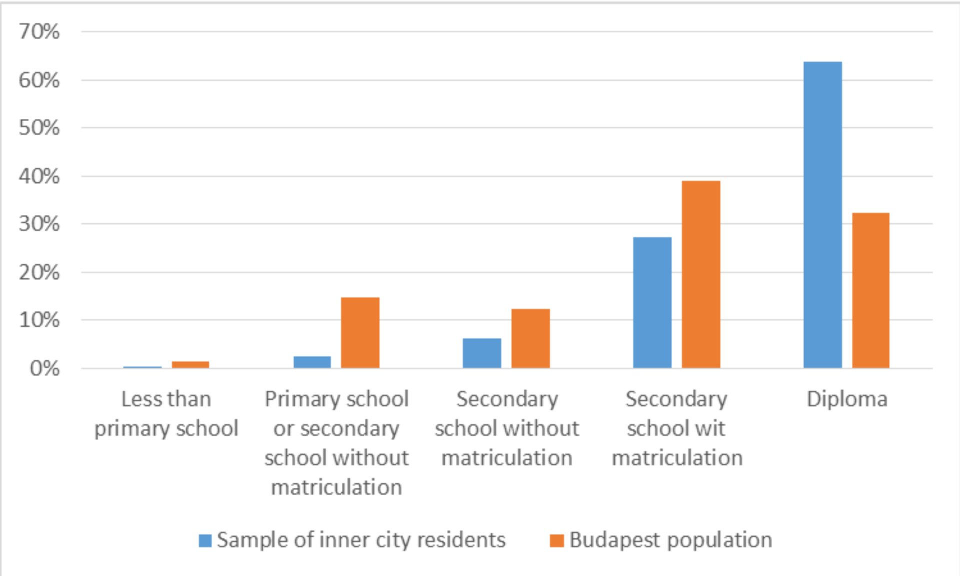


Figure 3. Distribution of the highest level of education among the inner city respondents and Budapest inhabitants who are over 18. Data source of the latter: KSH 2013

Similar patterns could be observed in the case of second and third questionnaires that is younger people and people with a diploma were overrepresented, while older people and lower educated people were underrepresented in the samples compared to the population of the 7th district (Figure 4., Figure 5. and Figure 6.). One exception is the age cohort of people between 18 and 35 in the case of the third questionnaire, who were underrepresented.

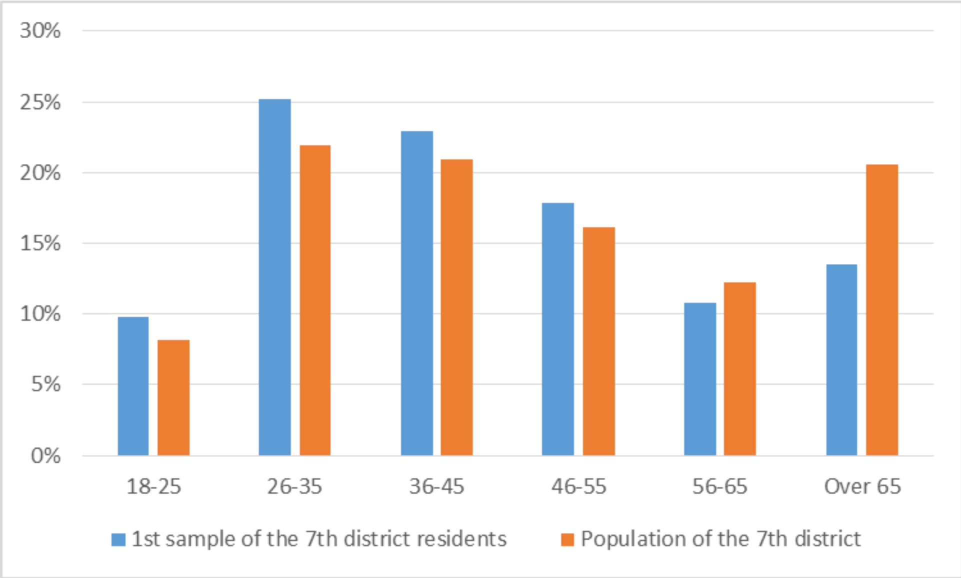


Figure 4. Age distribution of the respondents in the 1st sample of the 7th district and in the population of the 7th district who are over 18. Data source of the latter: KSH 2013.

Figure 5. Age distribution of the respondents in the 2nd sample of the 7th district and in the population of the 7th district who are over 18. Data source of the latter: KSH 2013.

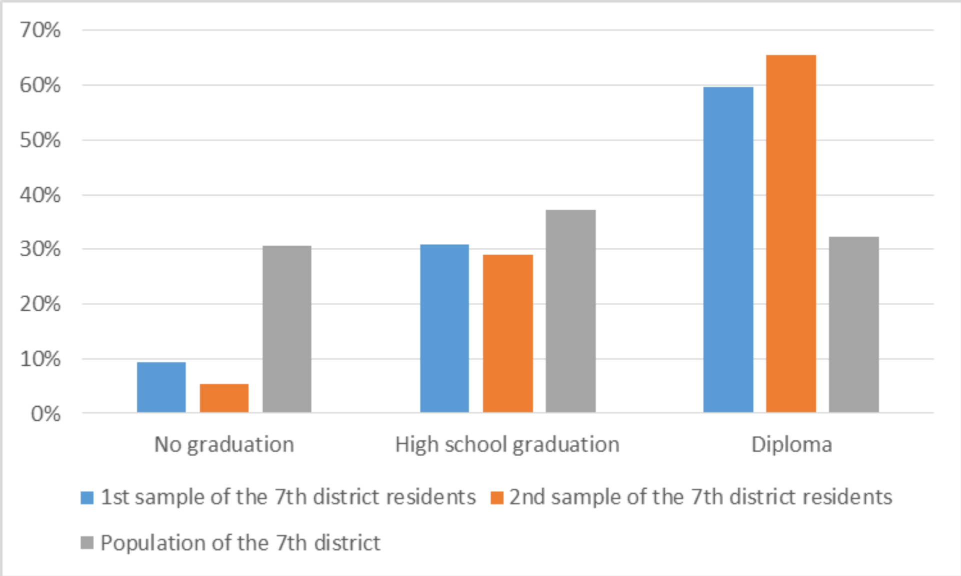


Figure 6. Distribution of the highest level of education in the samples of 7th district and in the population of the 7th district who are over 18. Data source of the latter: KSH 2013.

As the primary aim of the analyses were to explore public support regarding the current and potential distributions of mobility-related subsidies, in the analyses of the surveys, I aimed to determine the majority viewpoints regarding these issues. Then I explored how different factors determine these public views.

3.6 Limitations of the methods

Estimations of air pollution related subsidies (external costs) are rather uncertain in the literature, as both the contribution of transport to health harms caused by air pollution and the value of life (that is the basis of mortality costs) are disputed in the literature. Moreover, the value of public space is also uncertain, as it depends on regulation to a great extent. Therefore, in order to avoid overestimations, the calculations of subsidies relied on values acknowledged by many organizations or by legal sources. When these values diverged the lower values were used.

As the distribution assessment is based on the assumed mobility behaviour of representative characters, it might not reflect perfectly the actual distribution. However, this approximate assessment was sufficient for the research to demonstrate that there are individuals who receive different amount of mobility-related subsidies rather than to determine the exact distribution of such subsidies.

Finally, due to the online data collections, the samples of the questionnaire surveys were not completely representative of the adult population of the inner city or the 7th district, regarding age and the level of education. Therefore, I investigated whether the distribution of responses is different in the case of different age groups and people with different education levels.

3.7 Ethical considerations

The CEU Ethical research policy was fully respected during the research. Personal data (email addresses) were collected only in the case of the first questionnaire survey in order to allow the provision of rewards, but all personal data were permanently deleted later. In the case of the second and third questionnaires, no personal data were collected.

4 The characteristics of Budapest metropolitan area

This section aims to introduce the factors that are likely to influence the car domination in the inner city of Budapest to facilitate understanding the case study. As car domination is primarily the consequence of car driving and parking, the introduction focus on those who live and/or pursue daily activities (work or study) in this area. As most of these users live in the Budapest metropolitan area, the chapter explores Budapest metropolitan area based on statistical reports focusing on those characteristics that are likely to influence mobility[29] and public space use. It presents and justifies the demarcation of the inner city – the primary subject of this study.

4.1 The urban structure of the Budapest metropolitan area

This section provides a short introduction about the geography and demography of the Budapest metropolitan area. In order to facilitate understanding, it aims to provide a highly general picture of this area by partitioning it coarsely along the structure of the city to more or less homogenous parts and presenting the general demographic characteristics of these parts. Certainly, due to the complexity of the metropolitan area such a coarse partitioning cannot be regular, and the parts cannot be perfectly homogenous due to its coarseness. Still, even such an imperfect method can facilitate the contextualization of the case. It also presents that the inner areas of the city differ from the others not only regarding structure and demography, but also in that the distribution of potential trip destinations of the metropolitan area residents, such as workplaces, cultural facilities, etc. of Budapest (and the metropolitan area) are concentrated within the inner city.

Budapest's legally defined agglomeration area (including Budapest) covers 2,540 km^2 where 2.535 million people live, while Budapest itself has a territory of 525 km^2 and 1.729 million residents (KSH 2013a). As Figure 1. shows, the population density is much higher in Budapest, and particularly in the inner city. The relief of the metropolitan area is relatively flat, except its hilly north-western part. Its most conspicuous landmark is the river Danube that crosses the metropolitan area from the north to the south. Within the metropolitan area, nine bridges connect the two sides of the Danube. All of them are located in Budapest: seven of them are located rather close to the inner city and the remaining two are parts of the motorway half-ring at the border of Budapest. The Danube divides the city to Buda to the west side and Pest to the ease side of the river. While Pest, the area of which is around the double of the area of Buda and hosts 71% of the Budapest population (KSH 2017), is rather flat, the relief of Buda is much hillier, except some flat areas along the Danube.

[29] It is assumed that when a factor influences mobility, it influences car use as well.

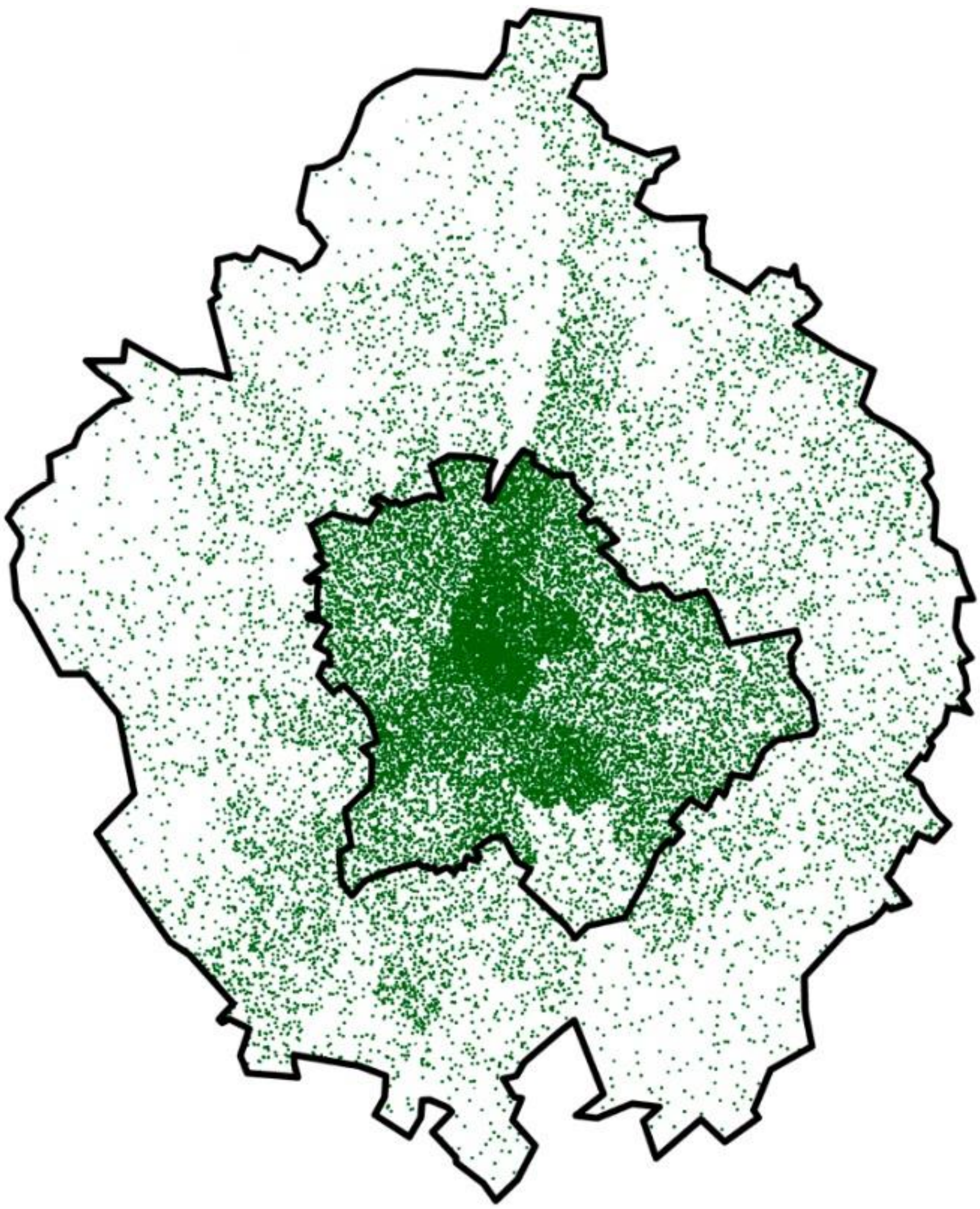


Figure 7. The distribution of the population in Budapest and in the Budapest metropolitan area. Each point signifies 100 people. Source: KSH (2013a).

One of the most obvious ways of partitioning the Budapest metropolitan area is based on the structure that refers to the way of development and the amalgamation of different functions. The Budapest 2030 Long-term Urban Development Concept (Budapest Mayor’s Office 2011) partitions Budapest in this way into five distinct zones (Figure 8.). While I agree with the demarcation of four of these zones, I think the distinction of the zone along the Danube is unnecessary, as its parts adjacent to the other zones are rather similar to those of adjacent zones[30]. Therefore I consider it more heuristic to incorporate these parts to the adjacent zones and differentiate only the following four zones within Budapest:

1. The inner area, characterized by continuous developments, where the residential and institutional (offices, administration, services) functions prevail. It accommodates around 15-17% of the population of the metropolitan area.

2. The hilly area of Buda, characterized by detached house developments and forested areas where the residential function prevails. It accommodates around 6-7% of the population of the metropolitan area.

3. The transition half-ring around the inner area (mainly in Pest, but also in the southern and northern parts of Buda), where the industrial and residential functions mingle. However, much of the industrial area is underutilized and decaying brownfield areas It accommodates around 15-20% of the population of the metropolitan area.

4. The outer residential area is characterized by a mixed housing estate, detached house developments and agricultural areas. It accommodates around 32-36% of the population of the metropolitan area.

[30]The Budapest 2030 Concept also admits that the features of different sections of the zone along the Danube are associated with the adjacent zones.

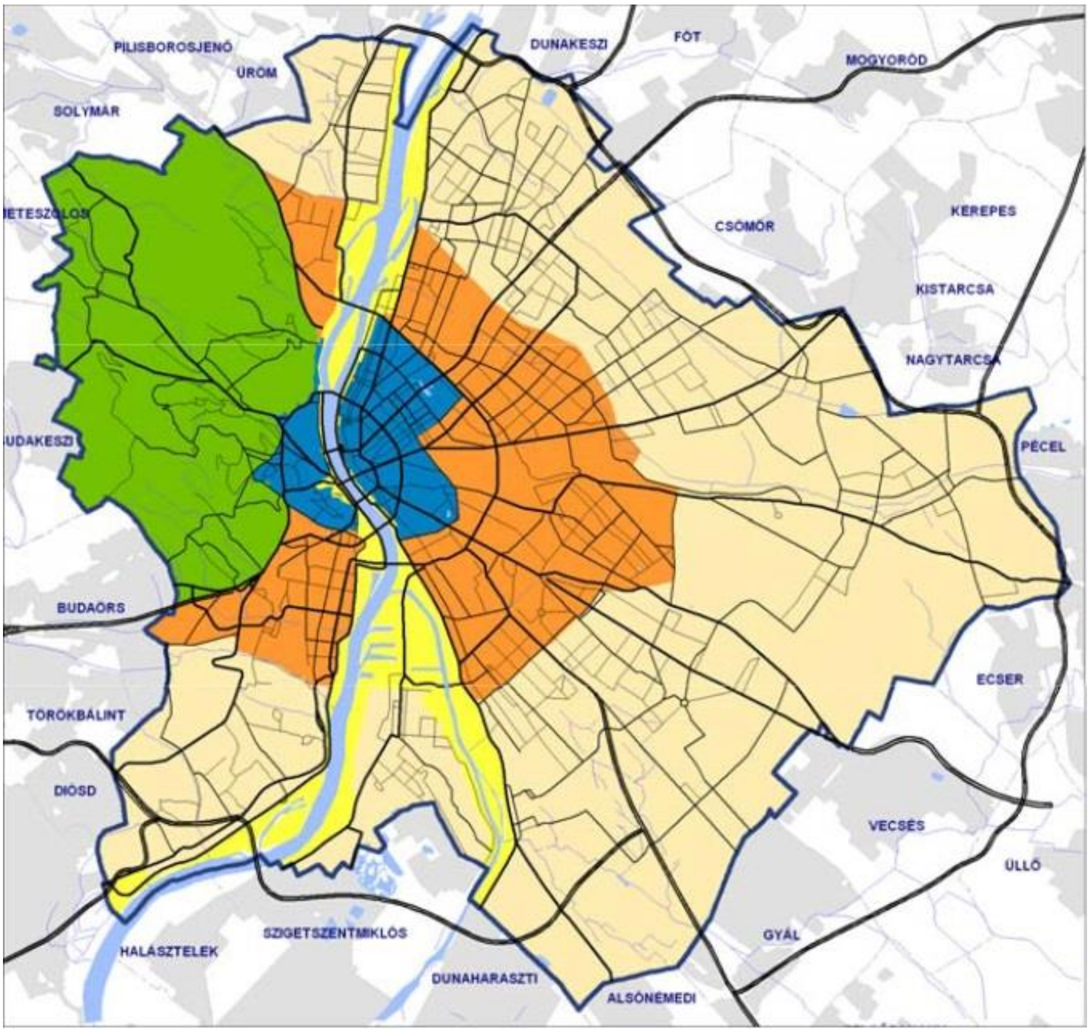


Figure 8. The five distinct zones of Budapest according to the Capital Development Plan. Dark blue: the inner area, orange: the transition area, green: the hilly area of Buda, light brown: the outer residential area, yellow: areas along the Danube (the last zone is incorporated into the adjacent zones in this study). Source: Budapest Mayor's Office 2011

Regarding Budapest's surrounding, it mainly consists of sparsely distributed settlements characterized by detached house developments, and agricultural areas, forests, and wetlands. It accommodates around 30% of the population of the metropolitan area.

Certainly, this partition (like any territory-based partition of any city) is not perfectly regular. For instance, the transition half-ring which is interrupted by substantial residential areas, and there are significant industrial areas in the outer residential area (Figure 9.).

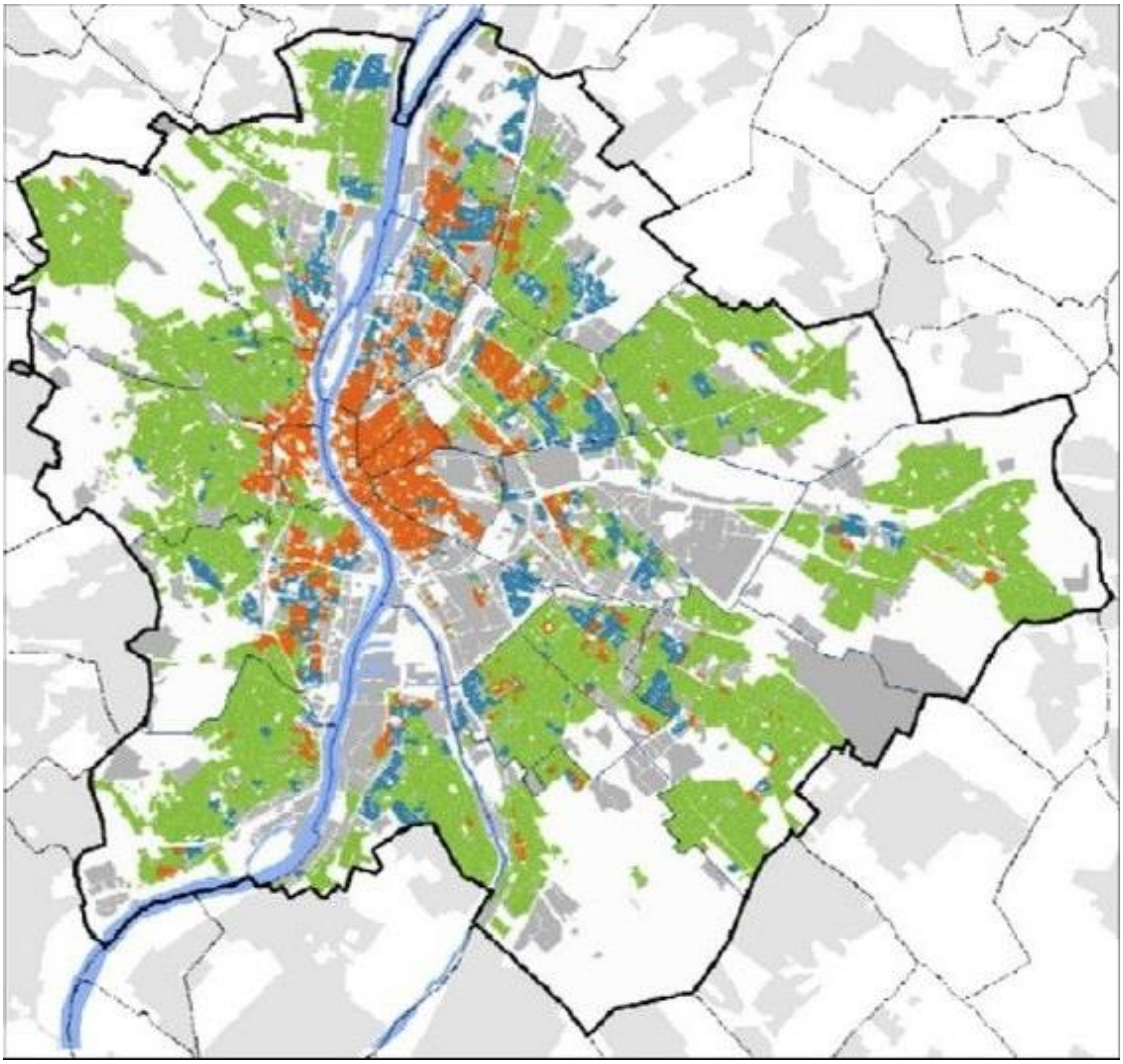


Figure 9. The types of developments in Budapest (orange: continuous developments; blue: housing estate developments; green: detached house developments; grey: brown-fields, industrial areas retailer or leisure complex, exhibition areas; white: large parks, forests or agricultural areas). Data source: Budapest Mayor's Office (2011)

This structure is the result of historical processes and natural endowments. Much of the inner area of Budapest was formed in the pre-industrial era, when most of the area was occupied by residential and public buildings, and production took place in workshops and in small factories (Balazs 2011). Due to the lack of available space in the inner area, the large factories of the industrial revolution were installed on the flat area around the inner area- this is the transition zone today. The hilly area of Buda was unsuitable for industrial activity and so it was transformed into a residential zone during the 20^{th} century (Balazs 2011). The outer residential zone already accommodated many small settlements in the pre-industrial era, which grew exponentially during industrial development to supply the workforce to the factories. In 1953, these settlements were incorporated into Budapest. In the communist era, when a significant part of the rural population moved to Budapest, mostly the outer residential area accommodated this population growth by forming the large housing estates as the other zones were mostly occupied (Balazs 2011). After the regime change in 1989, much of the industry collapsed, and large parts of the transition zone became a decaying brown-field area. Simultaneously the motorization rate skyrocketed, which at the same time allowed, encouraged and forced the exodus of Budapest residents seeking more liveable places in the neighbourhood of Budapest (Balazs 2011).

Table 2. aims to demonstrate that the above five zones differ not only regarding their structure but also in their demographic characteristics. As data about the zones are not available, the data of districts that fell entirely into a certain zone are used as proxies of the zones. As no district fall entirely into the transition zone, that zone is excluded from this comparison. In the case of Budapest's neighbourhood, the data of the agglomeration ring, the data of Pest county, or the data of the neighbouring administrative districts were used. To facilitate contextualisation, the relevant data of Budapest and Hungary are also presented. Besides the combined data of the zones, data of the districts are also presented to demonstrate the homogeneity of the zones.

Table 2 Some of the demographic characteristics of different parts of Budapest, the surroundings of Budapest and Hungary. Data source: KSH 2013a, KSH 2015, KSH 2017, KSH 2019

	Proportion of people over 60	Proportion of people under 14	Average household size	Number of cars per 1000 households[31]	Income per active person (EUR/year) 2016	Average price of a flat or house (1000 EUR) 2018
Inner city districts (1st, 5-8th districts)	25% (23-32%)	10% (9-13%)	1.78 (1.68 - 1.86)	470 (417 - 652)	8.845 (7,477 – 11,439)	92
Hilly districts in	32%	16%	2.02	688	12.956	143

[31]In the last couple of years the number of cars has considerably increased throughout Hungary. Assuming that the average household size have not changed, the number of car per 1000 households in Pest county (the county that surrounds Budapest) was 1065 in 2017. (http://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_wdsd003b.html)

Buda (2nd and 12th districts)	(32-32%)	(16-17%)	(1.97 - 2.05)	(652 - 712)	(12,914-13,019)	
Outer city districts (4th, 15th-23th districts)	27% (24-28%)	14% (13-16%)	2.29 (2.18 - 2.51)	796 (699 - 979)	8,207 (7,423 – 9,589)	73
Budapest	27%	13%	2.05	655	9,207	
Surroundings of Budapest	21%	17%	*2.81*	*915*	7,369 (2012)	*67 – 111*
Hungary (2011)	24%	15%	*2.36*	722	6,013[32] (2012)	

Based on the data of Table 2. the demography of the above zones can be summarized as follows:

1. In the inner area working-age people are overrepresented while children are strongly underrepresented. Probably partly due to the lack of children, households are rather small. Car ownership is low, in spite of the moderate income.

2. In the hilly area elder people are strongly overrepresented. Probably partly due to the high number of elder people, households are somewhat small. Car ownership is moderate, in spite of the relatively high income.

3. Though precise data about the transition half-ring are not available, the data of the remaining districts (the territory of which is shared among the different zones) suggest that in most aspects, the population of this zone can be characterized by average values of Budapest.

4. In the outer residential zone children are slightly overrepresented. Car ownership is moderate, in spite of the relatively low income.

5. In Budapest's surroundings elderly people are underrepresented, while children are overrepresented. Car ownership is relatively high.

It must be noted that there is no substantial difference in the income of active persons and housing prices between Budapest and its surroundings. This suggests that the majority of people who commute to Budapest, and particularly to the usually well-paid inner city workplaces, are likely to reside in the suburbs not because the high housing prices pushed them out from Budapest, but because they prefer to do so. Certainly, it can be the case that a flats or houses are smaller in Budapest than similarly priced houses in the suburbs and so a family of five or more can afford a sufficiently large place only outside Budapest, but the number of such families is assumingly rather low in Budapest metropolitan area

Regarding the context of car use, besides the structure and demography, the distribution of potential destinations are also likely to be highly relevant in seeking characteristics patterns of the Budapest metropolitan area. The distribution of many potential destination categories suggests a rather monocentric structure, in which the closer a location is to the centre of the city, the higher the density of potential destinations. As 40% of travels is commuting to work (Városkutatás Ltd. 2009), the most important mobility destination is the workplace. Figure 10. displays the concentrated distribution of offices, as the probably most common workplaces in Budapest, within and next to the inner areas of Budapest.

[32] Assuming that income has raised in the same extent in Budapest than elsewhere, the income per active person was 8,327 and 6,795 EUR/year in the surroundings of Budapest, and in Hungary, respectively.

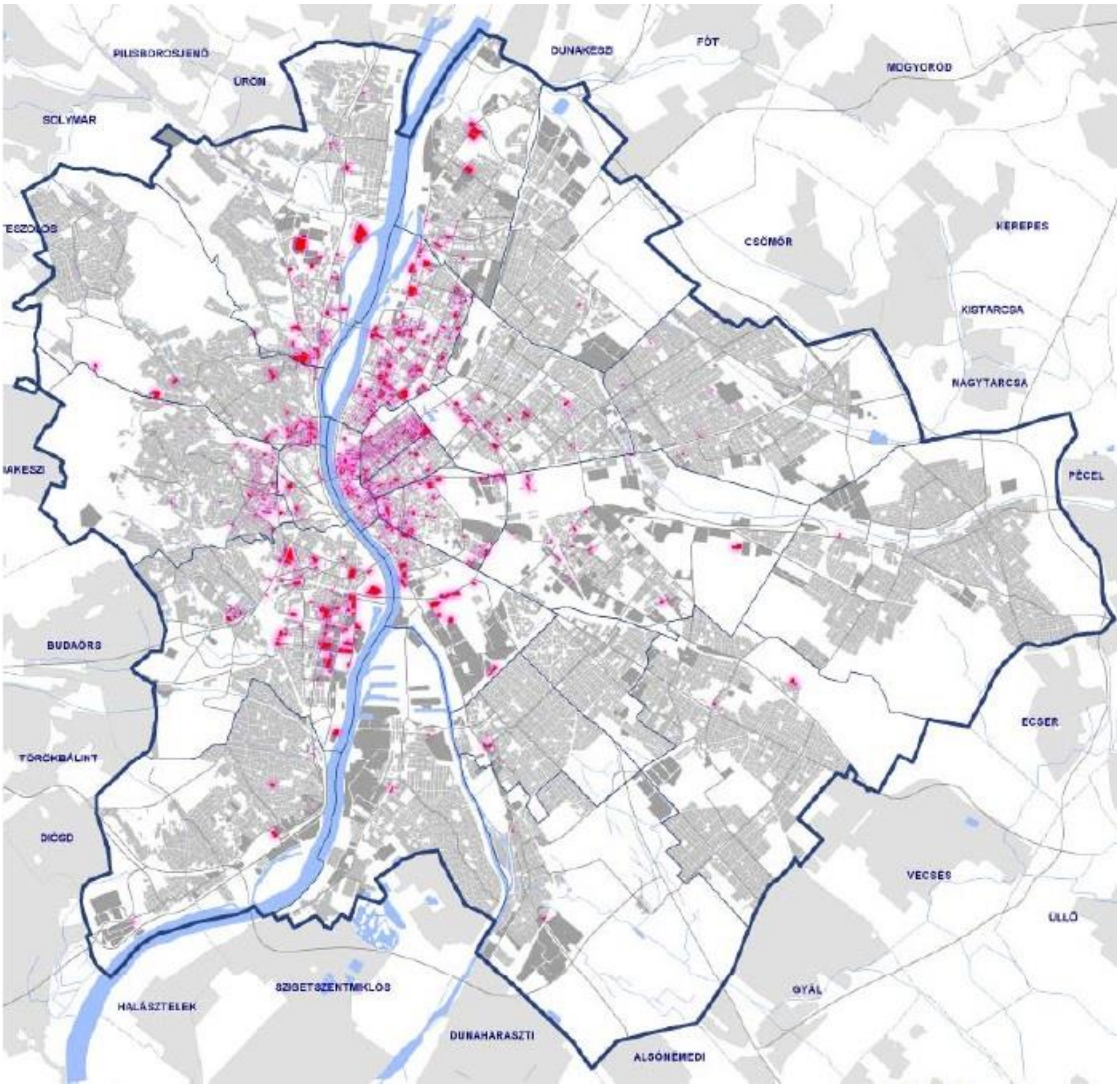


Figure 10. The location of office areas (purple) in Budapest. Source: Mayor's Office 2011

Though this map suggest that the location of office areas is rather concentrated in Budapest, it must be noted that earlier it was even more concentrated. Because, while the number of workplaces in Budapest decreased by 30% between 1970 and 2011, the number of primarily office-based workplaces decreased by 67% in the most inner 5th district of Pest[33] (Lakatos and Kapitány 2015). This means that regarding the inner city, urban sprawl had a greater effect on workplaces than on the population, since the latter decreased 'only' by 58% in the same district (and by 14% in

[33] The number of office-based workplaces was likely to decrease to a less extent in Budapest as the same time the economy of the capital became more service-based.

Budapest) during the same time (Lakatos and Kapitány 2015). The ceased office areas of the 5th district was substituted partly by new office areas somewhat further from the city centre but still in its proximity.

The concentration of facilities close to the centre of Budapest is much greater than that of office areas. Regarding education, the higher the level of education is, the higher the overrepresentation of the educational institutes of that educational level in the inner city is (Figure 11. a and b). In higher education and cultural institutions, the overwhelming proportion of facilities are located in the inner city (Figure 11. b and c). In healthcare institutions, there is also a concentration in and around the inner city though it is much less accentuated (Figure 11. d). It seems that urban sprawl has much less impact on facilities, probably partly due to the strong traditional ties of these facilities to their buildings or to their inherent ties to the inner city. Though there are not available maps about them, the central administration institutions (the Parliament, the ministries etc.), the central or national institutions are also likely to be concentrated highly close to the centre, too, partly due to their traditional ties to the city centre.

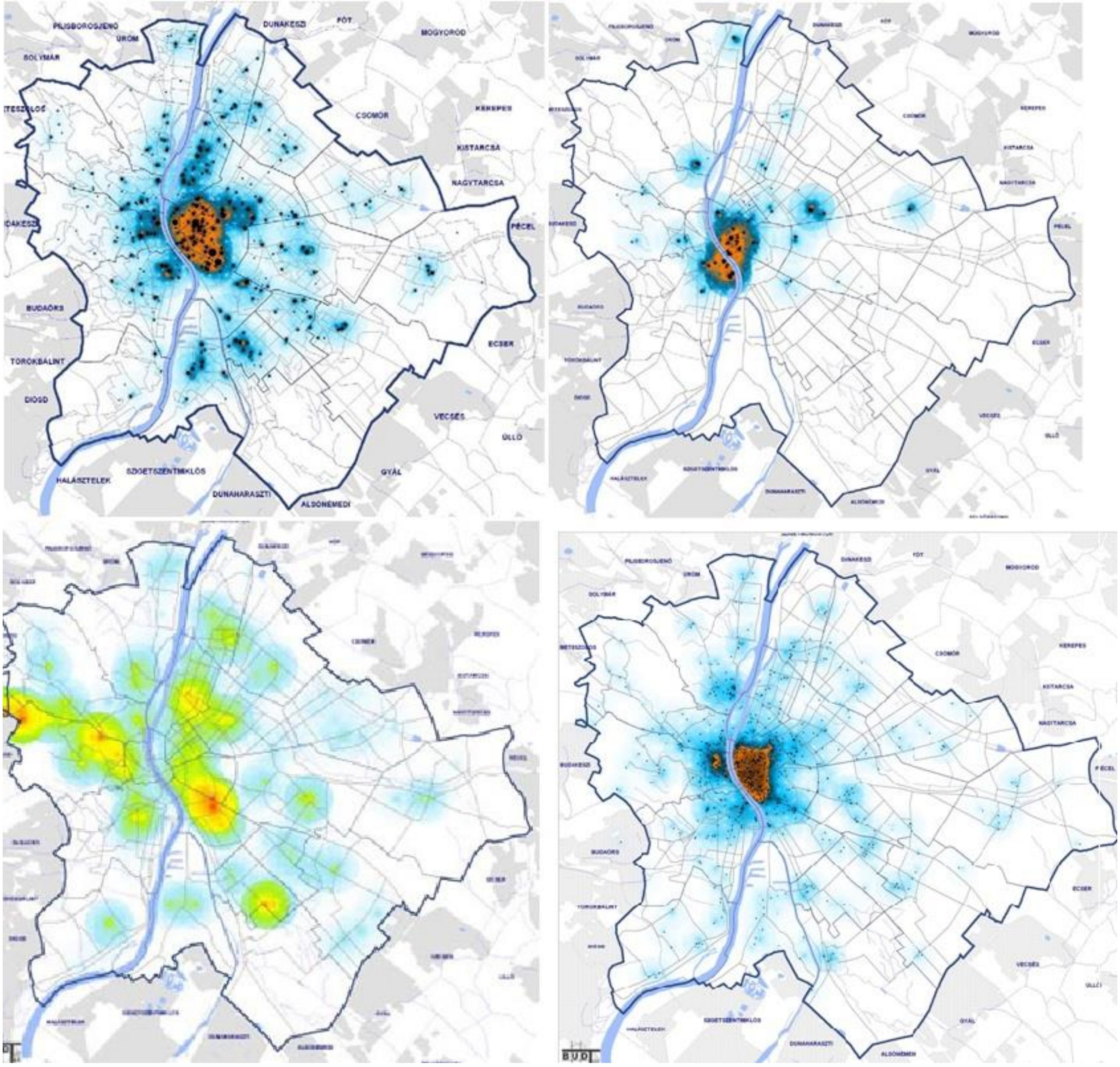


Figure 11. Clockwise:
a, the location of secondary schools and the student density in Budapest
b, the location of higher education institutes and the student density in Budapest
c, the number of cultural facilities per ha in Budapest
d, area of health institution per ha in Budapest
Sources: Mayor's Office 2011

4.2 Demarcation of the inner city

As this study aims to contribute to understanding the car domination in the inner cities, the demarcation of the inner city of Budapest displayed in Figure 12. was used in this study. The following arguments justify the demarcation in this way:

1. The perspective of the study required an inner city that is primarily continuously developed (which entails a lack of private outdoor space), is densely populated (which allows frequent, dense

and efficient public transportation), is relatively small (which facilitates bike use), and accommodates plenty of potential destinations, such as administrative, educational, cultural and other facilities (which allows the satisfaction of many needs within the inner city). As the inner area of Budapest described in the partition above complies rather well with these requirements, the demarcation of the inner city used in this research was based on that area.

2. However, the first questionnaire survey on which the study relies to a great extent have required an easy perception of the inner city. Therefore, the inner city was demarcated along important, well-known roads when it was possible. Thus in the Pest side the Hungaria Ring-road was chosen as the border of the inner city as it is an easily describable road that includes the overwhelming part of the area considered as the inner city according to the first argument. Nevertheless, it contains some detached house and industrial developments, particularly along the southern section of the boulevard, that do not really comply with the requirement of the inner city, and excludes some continuous development outside its northern section that could be considered as part of the inner city. The demarcation of the inner city on the Buda side by the Lagymanyos Bridge, the BAH junction, the Szell Kalman square, and Arpad bridge was less describable, but due to the lack of a large circular road similar to Hungaria Boulevard, it seemed to be the most obvious demarcation. However, this demarcation includes the non-continuous development of Gellert-Hill and excludes some continuous developments between the BAH junction and the Arpad bridge that again could be considered as part of the inner city. Nevertheless, the number of people included in or excluded from the inner city inappropriately is likely to be a rather small compared to the population of the inner city and so their involvement in or exclusion from the survey are unlikely to influence the findings to a great extent.

3. The disposition of districts in Budapest is such, that an inner city cannot be demarcated along their borders. Therefore, adjusting the border of the inner city to the border of the districts in order to facilitate statistical data collection and comparison was not a standpoint in demarcating the inner city. On the other hand, the highly relevant feasibility study of the congestion charge in Budapest

(Városkutatás Ltd.. 2009) had applied a rather similar demarcation (Figure 12. b). As I planned to use the data used of the feasibility study, it was important to use a similar demarcation of the inner city.

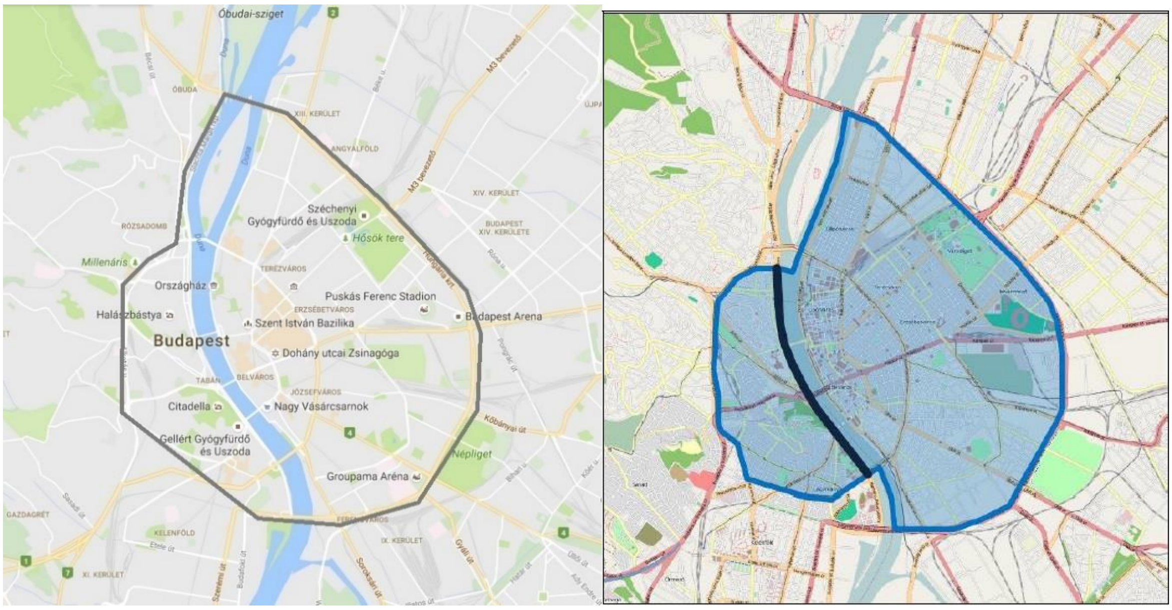


Figure 12.
a, (bottom, left): The demarcation of the inner city in this study. Data source: googlemaps.com
b, (bottom, right): The demarcation of studied area in the feasibility study of Budapest congestion charge. Source: Városkutatás Ltd.. 2009

While focusing on the inner city, the study also differentiates the outer city of Budapest (which refers to the parts of Budapest outside the inner city) and the suburbs (which refer to the agglomeration ring of Budapest), because their characteristics are rather different and their residents behave rather differently regarding the perspectives of inner city car use (Table 2.). First, as the limits of parts of Budapest presented above are rather blurred, particularly in the case of the transition half-ring, their use might entail confusion in data classification (that is it might not have been clear that a place associated with a person or data is located in this or that part of Budapest). Secondly, in the case of the survey, the low number of respondents outside the inner city did not allow a finer classification without risking a significant reduction in the reliability of the data. Table 3. displays the most important characteristics of these three different zones:

Table 3. The characteristics of the different parts of the Budapest metropolitan area (Városkutatás Ltd., 2009, Stratégia Konzorcium 2013).

	Inner city	Budapest's outer parts	Budapest's surroundings
Number of residents (in 1000)	380	1350	800
Territory (km^2)	50	475	2000
Density (person/ha)	760	284	40
Number of cars per 1000 households	420	600	869
Percentage of monthly pass holder Budapest residents between 7 and 65	~46%		
Percentage of households that own a bike	~26%	~60%	
Annual volume of car traffic (10^6 vkm)	3576		
Annual volume of passenger traffic by car (10^6 pkm)	4649		
Annual volume of passenger traffic by public transportation (10^6 pkm)	5868		

4.3 Mobility in Budapest metropolitan area

This section explores the mobility patterns, the infrastructure, the services and economics of car use, public transportation use and cycling in Budapest and in its surroundings.

4.3.1 Mobility patterns in Budapest

The general modal split among travel modes depends on the location to a great extent (Figure 13.). It must be noted that the modal split dramatically changes at the border of Budapest. However, in spite of the decreasing modal share of car use in Budapest towards the centre, still approximately 290-300 thousand cars enter Budapest (Jászberenyi 2008, BFK 2021), and 400 thousand cars enter the inner city (based on Városkutatás Ltd. 2009, see details below) on an average weekday.

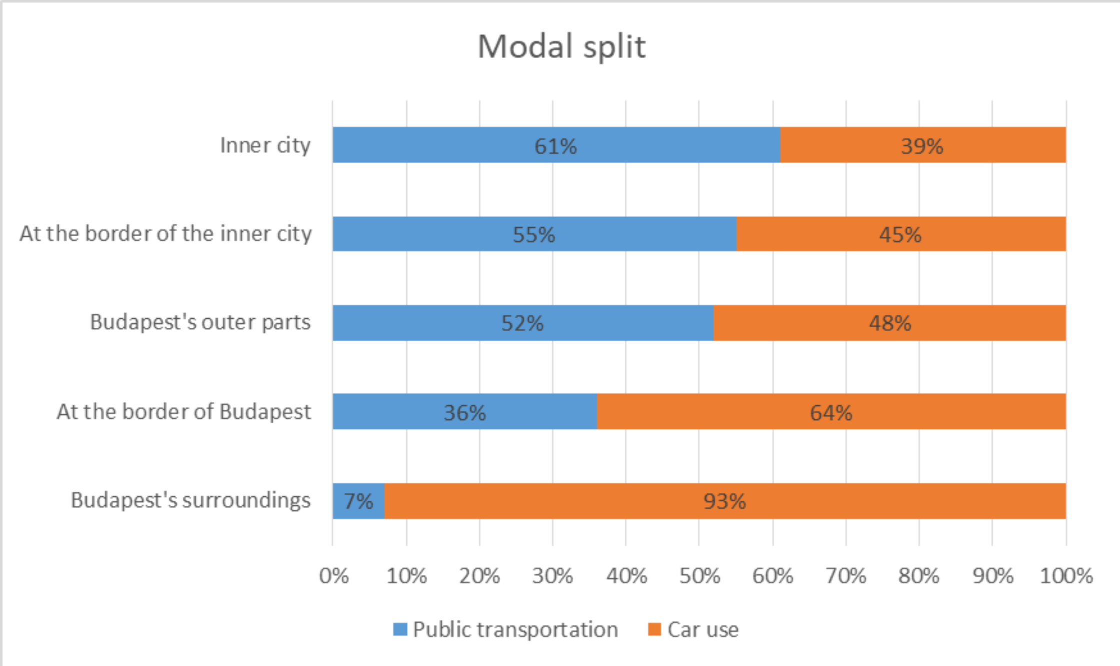


Figure 13. The modal split between public transportation and car use in different parts of Budapest. Data source: (Városkutatás Ltd. 2009, Budapest Mayor's Office 2011).

Regarding cycling, there are available data about its modal share only in the case of Budapest. Figure 14. presents the modal split in 2017 and the planned modal split in 2030 among public transportation, car use and cycling in Budapest. Compared to the cycling capitals of Europe (Copenhagen: 49%, Amsterdam:34%, based on ECF 2019), the share of cycling is extremely low, and the target for 2030 is not very ambitious.

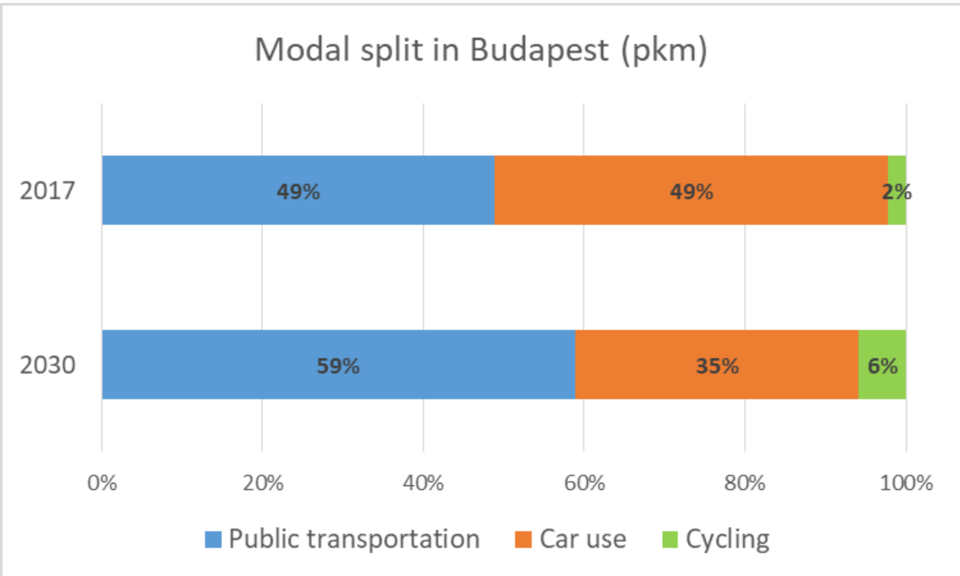


Figure 14. Modal split in Budapest in 2017 and planned modal split in 2030.

The matrix of place of residence–workplace (Appendix 1) created from the 2011 census provided by the Hungarian Central Statistical Office (KSH) allowed me to estimate the shares of inside, short and long inbound, short and long outbound and through trips in the field of commuting to work (referred hereinafter as ‘commuting to work’ trips) that constitutes around 40% all trips (Városkutatás Kft. 2009). These categories refer to the following trips:

- inbound trips: those 'commuting to work' trips of non-inner-city residents that target inner city workplaces. Any trip targeting such a destination must be located at least partly in the inner city, as their destination are located in the inner city. Assuming that the inner city workplaces are located in a way that their centre of gravity is the central point of the inner city, the length of the inner city section of the average inbound trip is equal to the radius of the inner city. Short and long inbound trips are differentiated in the study, short inbound trips originate from outer Budapest, long inbound trips originate from outside Budapest.

- inside trips: those 'commuting to work' trips of inner city residents that target inner city workplaces. Any inside trip is located inherently in the inner city as its destination is located in the inner city. Assuming that the inner city workplaces are located in a way that their centre of gravity is the central point of the inner city, the length of the average inside trip is equal to the 2/3 of the radius of the inner city, as the average distance between a random point of the circle disc and the central point of the disc is equal to the 2/3 of the radius of the circle (Mathematics 2017).

- outbound trips: those 'commuting to work' trips of inner city residents that target workplaces outside the inner city. A section of these trips are located in the inner city only because the trip maker resides in the inner city. As the inner city residents are distributed randomly in the inner city, the length of the inner city section of the average outbound trip equals to the radius of the inner city. Short and long outbound trips are differentiated in the study, short outbound trips target outer Budapest, long outbound trips terminate outside Budapest.

- through trips: those 'commuting to work' trips of non-inner city residents that target workplaces outside the inner city, but their places of residence workplaces are located in the completely opposite side of Budapest. As the traffic of Budapest is based on radial roads and the few peripheral roads are either congested, fragmented or located far from the inner city, the 'commuting to work' trips of these people are likely to traverse the whole inner city. Therefore, it is assumed that through inner city trips on average are twice as long as the radius of the inner city (it is also assumed that in those cases when the place of residence are the workplace situated not completely opposite side of Budapest, then the 'commuting to work trip' takes place on routes outside the inner city).

The cell in the row of district x and column of district y means the number of commuters who reside in district x and work in district y. Some respondents stated that they work in Budapest but did not specify the district of their workplace, they are included in the 'unspecified district' column. People who do not reside in Budapest but work there, and people who reside in Budapest, but work in other settlements are also included in the matrix

In order to estimate the number and shares of different types of trips at first inner city place of residences and inner city workplaces were determined as follows:

- all places in the 1st,5th, 6th, 7th and 8th ,districts were defined as inner city places, as their territories fall entirely in the inner city

- all places in the 3rd, 4th,10th, 15th -23rd districts were defined as outer city places, as their territories fall entirely in the outer city.

- all other districts (2nd, 9th, 11th, 12th, 13th, 14th) include inner and outer city parts, they are called 'mixed districts' (Figure 15.). In their case, the number of residents and workplaces in the inner part were estimated on the basis of their inner city territory and the average resident and workplace density of the inner city districts. As the total territory of the inner city districts is around 17.3 square km, the number of residents is around 220,000 (KSH 2015) and the number of workplaces is around 200,000 (KSH 2016), the residents and workplace densities of the inner city districts are around 12,700 and 11,600 per square km. Table 4. shows the inner city territories of mixed districts (calculated with the help of GoogleEarth), and the estimated numbers and shares of inner city residents and workplaces in the mixed districts. Certainly, this way of estimation has limitations, as the densities of residents and workplaces vary in the different location within the inner city. However, for lacking anything better the above estimation method was used in this study.

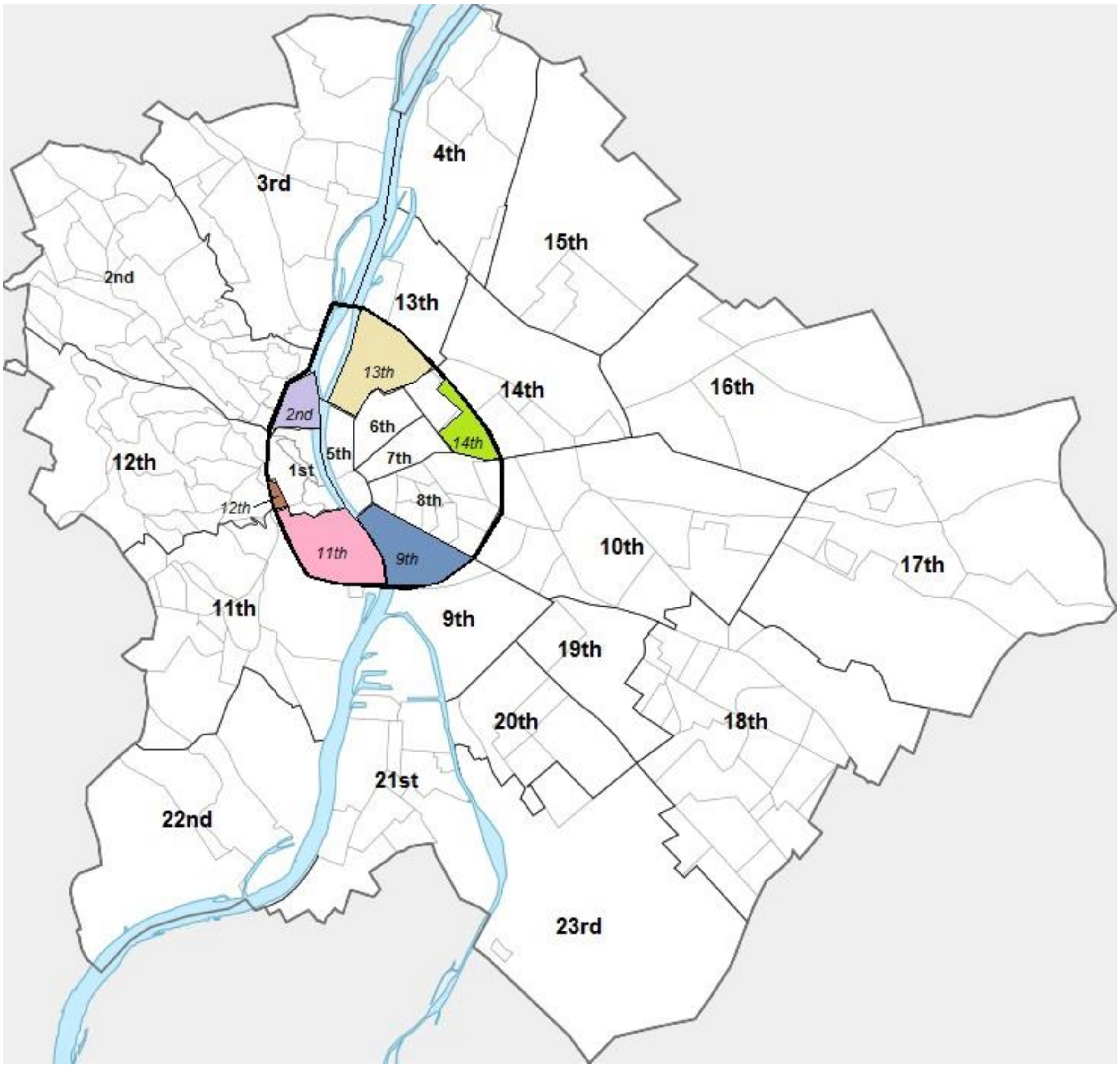


Figure 15. The districts of Budapest and their relation to the inner city. The areas with different colours illustrate the inner city territories of mixed districts. The Margaret Island located west from the inner city territory of the 13th district (part of the 13th district) and the City Park located northwest from the inner city territory of the 14th district (part of the 14th district) were not included in the calculation of the inner city territories as they are rather large and mainly covered by parks (thus their population and workplace densities are very low) and so their inclusion would considerably distort the calculations. Data source: https://commons.wikimedia.org/w/index.php?curid=44639693

Table 4. The share of population and workplaces in the inner city parts of mixed districts.

District	Territory of inner city part (km^2)	Inner city residents	Inner city workplaces	Share of population in the inner part	Share of workplaces in the inner part
2nd	0.7	8,890	8,120	10%	17%
9th	3.7	46,990	42,920	80%	75%
11th	4.3	54,610	49,880	37%	56%
12th	0.25	3,175	2,900	5%	9%
13th	3.8	48,260	44,080	40%	48%
14th	1.6	20,320	18,560	16%	31%

The number of inbound, inside and outbound trips were calculated as follows:

- in case of each person who resides or works in a mixed districts, it was considered random if he or she resides or works in the inner or the outer part of the district

- e.g. in the case of residents of the 9th district, it was assumed that, regardless of the location of their workplaces, 80% of them reside in the inner city part while the rest reside in the outer part. And in the case of people who work in the 9th district, it was assumed that, regardless of their place of residence, 75% of them work in the inner city part while the rest work in the outer part.

- any person who resides in the outer city and works in the inner city was considered to perform an inbound trip. Those who reside in outer Budapest were considered to perform short inbound trips, while those who reside outside Budapest were considered to perform long inbound trips.

- any person who resides and works in the inner city was considered to perform an inside trip

- any person who resides in the inner city and works in the outer city was considered to perform an outbound trip. Those who work in outer Budapest were considered to perform short outbound trips, while those who work outside Budapest were considered to perform long outbound trips.

The number of through trips were calculated as follows:

- in case of each person who resides or works in a mixed districts, it was considered random if he or she resides or works in the inner or the outer part of the district

- only those commuters were considered who reside and work in outer parts of mixed districts or in outer districts that are located in the opposite side of the inner city. Table 5. displays the pair of districts that comply with this definition. In Appendix 1. the cells in accordance with this table are highlighted. And Figure 16. shows the example of the 2nd district. Certainly, based on the census data, one cannot be sure that the potential through commuters all traverse the inner city while commuting. Therefore, the number of through commuters were estimated by using a different method, too, which is presented at the end of this section.

Table 5. Districts, in the cases of which the commuting route between the place of residence and workplace is likely to go through the inner city.

District of place of residence or workplace	District of workplace or place of residence
2nd	9th, 10th,14th, 16th-21st, 23rd
3rd	9th, 11th, 18th-23rd
4th	11th, 18th-23rd
9th	2nd, 3rd, 12th
10th	2nd, 11th, 12th
11th	3rd, 4th, 10th, 13th
12th	9th, 10th, 13th-21st, 23rd
13th	11th, 12th, 20th-23rd

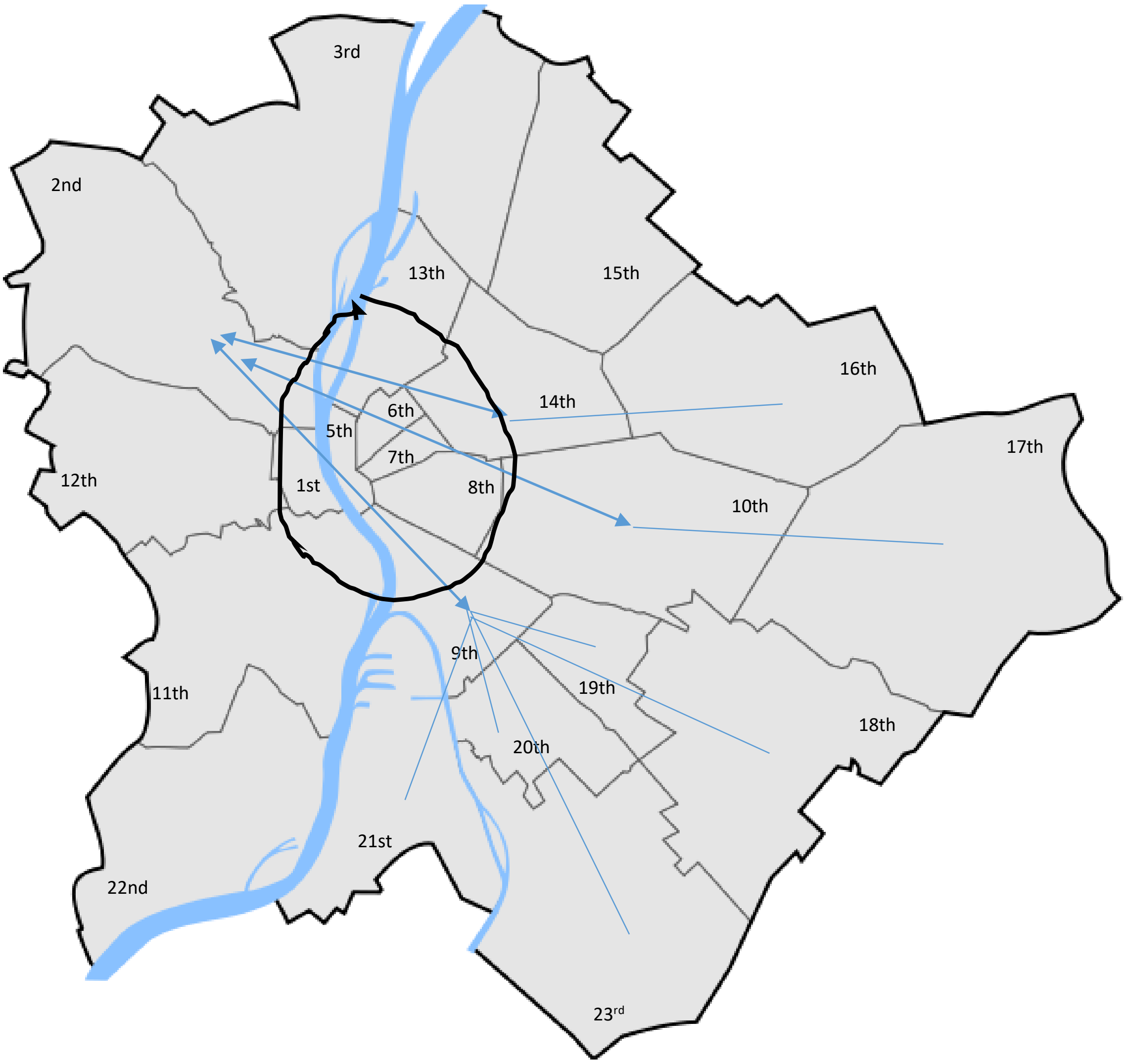


Figure 16. The location of the 2nd and those other districts, in the case of which the route between the 2nd and the other districts traverse the inner city.

Based on the place of residence–workplace matrix Table 6. shows the shares of different types of commuting traffic in the inner city. Those commuting trips that take place between Budapest's neighbourhood and Budapest' outer parts – there are 208,531 such trips per day – in a way that the commuters traverse the inner city could not be included in the calculation of through trips because the exact location of such places are unknown. Therefore, I estimate that at least 1% of these commuting trips traverse completely the inner city, which are around 2,000 through trips. Commuting trips that originate from outside Budapest and target a workplace outside Budapest in a way that traverse the inner city are ignored in this study due to the complete lack of data . In order to calculate the share of different types of traffic, the number of trips are multiplied with the relative average inner city length of the relevant trips that are 1r, 2/3r, 1r and 2r (r is the radius of the inner city) in the case of inbound, inside, outbound and through trips, respectively, as it was shown above.

Table 6. The shares of different types of commuting traffic in the inner city of Budapest r= tge radius of the inner city)

	Number of trips	Average length	Total length	Share
Short inbound traffic	167,412	1r	167,412	35%
Long inbound traffic	94,961	1r	94,961	20%
Inside traffic	103,808	2/3r	69,205	14%
Short outbound traffic	61,731	1r	61,731	13%
Long outbound traffic	21,227	1r	21,227	4%
Through traffic	**32,241**	2r	64,483	13%

Nevertheless, the shares of these traffic types in the case of car traffic are somewhat different, as the modal split differs in the different types of traffic. The matrix of place of residence–workplace of those who commute only with car (also provided by the Hungarian Central Statistical Office) allowed estimating the shares of the different types of commuting car traffic. As in the case of mixed district the modal split can be rather different in the two side of the border of the inner city, the shares of modal splits associated with the mixed districts can distort significantly the estimations about the shares of car users in the case of different kind of trips. Therefore, the mixed districts were left out from the estimation of the modal share of car use, and only purely inner or outer districts were used. As the purely inner districts are located in the middle of the inner city, the modal split of car use associated with them is likely to be lower than in the case of the whole inner city, but for lacking anything better, I will use their figure as a proxy of modal split of car use in the whole inner city. Table 7. displays the shares of different types of trips estimated above, the modal splits of car use in their cases and the shares of different types of trips in the inner city commuting car traffic.

Table 7. The shares of different types of commuting trips in commuting inner city car traffic.

	Number of all inner city trips	Modal split of car use	Number of inner city trips made by car	Average length	Share in commuting car traffic
Short inbound traffic	167,412	17%	28,460	1r	27%
Long inbound traffic	94,961	26%	24,689	1r	24%
Inside traffic	103,808	11%	11,418	2/3r	7%
Short outbound traffic	61,731	23%	14,198	1r	14%
Long outbound traffic	21,227	46%	9,764	1r	9%
Through traffic	32,241	31%	9,994	2r	19%

As the first questionnaire survey allowed determining whether a commuting trip inbound, inside or outbound and it also surveyed the mode of commuting, it also allowed the estimation of the shares of car use in the case of different commuting types (Table 8.), except in the case of through traffic which were not investigated. It must be noted that in the case of inside and short inbound trips the estimations of shares are rather similar in both method, the difference is only 1%. However, in the case of long inbound trips the difference is substantial (16%). This significant difference is most probably the consequence of the considerably more affordable fuel at the time of the survey (first quarter of 2016) compared to the time of the census (at the autumn of 2011) due to the 18% lower fuel prices (NAV 2017), the 26% higher average wages (Profession.hu 2016) and due to being less affected by the financial crisis of 2008-2009. As the affordability of fuel is likely to have a strong limiting impact on long commuting trips when fuel consumption is substantial, it seems conceivable that many long commuters switched to car use when the fuel became more affordable. On the other hand, in the case of short commuting trips fuel consumption is much lower and so the more affordable fuel was likely to have a much smaller impact on the modal split. In the case of outbound traffic short and long trips were not differentiated, therefore only the overall outbound modal splits of car use can be compared which was 35% according to the census data. The 4% higher share surveyed in the questionnaire might be also the consequence of higher share of car use in the case of long outbound trips. Table 7. shows the shares of different type of car traffic based on the modal split data of the first questionnaire survey. In case of outbound traffic, it was assumed that the share of short outbound commuters by car is 1% higher, and the share of long outbound commuters by car is 13% higher than the share derived from the census data (and so their combined share is 4% higher than in the case of census data). The share of through commuters by car was assumed to be 5% higher compared to the census data, as the distances of through commutes fall between the distances of short and long inbound trips.

Table 8. The shares of different types of commuting car traffic in the inner city of Budapest based on the questionnaire survey.

	Number of all inner city trips	Modal split of cars	Number of inner city trips made by car	Average length	Share in commuting car traffic
Short inbound traffic	167,412	18%	30,134	1r	23%
Long inbound traffic	94,961	42%	39,883	1r	31%
Inside traffic	103,808	12%	12,456	2/3r	6%
Short outbound traffic	61,731	24%	14,815	1r	11%
Long outbound traffic	21,227	59%	12,523	1r	10%
Through traffic	32,241	36%	11,606	2r	18%

The somewhat high share of outbound and through traffic (30% of commuting traffic and 39-42% of commuting car traffic) is surprising. The residential choice theory (Evans 1972) suggest that inbound and inside trips constitute the overwhelming part of inner city commuting traffic, as workplaces tends to concentrate in the inner city and the inner city residents' main motivation for residing in the inner city is supposed to be the proximity of their inner city workplaces. And even if many workplaces relocate outside the inner city (workplace suburbanization), it is commonly supposed that then inner city residents follow the workplaces, too. Nevertheless, in Budapest the share of outbound commuting traffic is 17%, because 44% of inner city working residents are working outside the inner city, and even 32% of the central district workers work outside the inner city. According to the residential choice theory, many of these people would be better off if they would reside outside the inner city, closer to their workplaces, as their transport costs would be lower and either their housing cost would be lower or they could afford better housing conditions. Why then do they reside in the inner city? This question will be analysed in the 5.1.2.2. section of this chapter.

The somewhat high share of long commutes is also interesting. One might assume that in the inner city car traffic of a large city consists mainly of trips made by the inhabitants of the city who target city destinations. However, in Budapest, the 33-41% of inner city commuting car traffic is made up by either non-residents of Budapest, or by residents who target a workplace outside Budapest.

Finally, the somewhat high share of through car traffic is unexpected, too. Why do so many people undertake the inconveniences of traversing the often congested inner city twice a day? Certainly, as it was mentioned above, it is rather difficult to estimate the number of through commuters, as there is no data about their commuting routes, and so it cannot be ruled out that the many potential through commuters actually take a large detour to avoid the inner city. Nevertheless, the estimation of Városkutatás Ltd.. (2009), according to which 467,315 vehicles enter the inner city on roads on a weekday including buses and taxis and excluding those who cross the whole inner city on the quayside road on Buda side (Figure 1.), also suggest that through traffic has a considerable share in the inner city car traffic. Assuming that an average taxi from the taxi fleet of 5,000 (24.hu 2017) enters the inner city 5-10 times a day and an average bus of the bus fleet of 1,400 (KSH 2013b) enters the inner city 10-20 times a day, the number of entering cars and trucks is estimated around 400,000. It must be noted that duty vehicles above 7,5 t can enter much of the inner city only for a fee and with the consent of the mayor of Budapest, therefore such vehicles are likely to enter the inner city in a minimal number. According to the survey of purposes of the same study and the above-mentioned survey of the KSH, around 40% of these entries – that is around 160,000 entries - are related to commuting to work. However, according either to the KSH or the questionnaire survey, only 77,000 or 97,000 inbound and outbound commuters cross the border of the inner city a day, respectively. Therefore, the 160,000 'commuting to work' entries presuppose that there are around 30-40,000 through commuters who enter twice a day into the inner city during their commutes, which number does not even include those commuters who traverse the inner city through the quayside road of Buda and assumes that each car is used by only one commuter. That is the estimated number of around 10-12 thousands through commuters by car might be a significant underestimation of the actual number of through commuters. It might be the case that many commuters for whom the route on peripheral roads could be potentially suitable still traverse the inner city due to the congested peripheral roads.

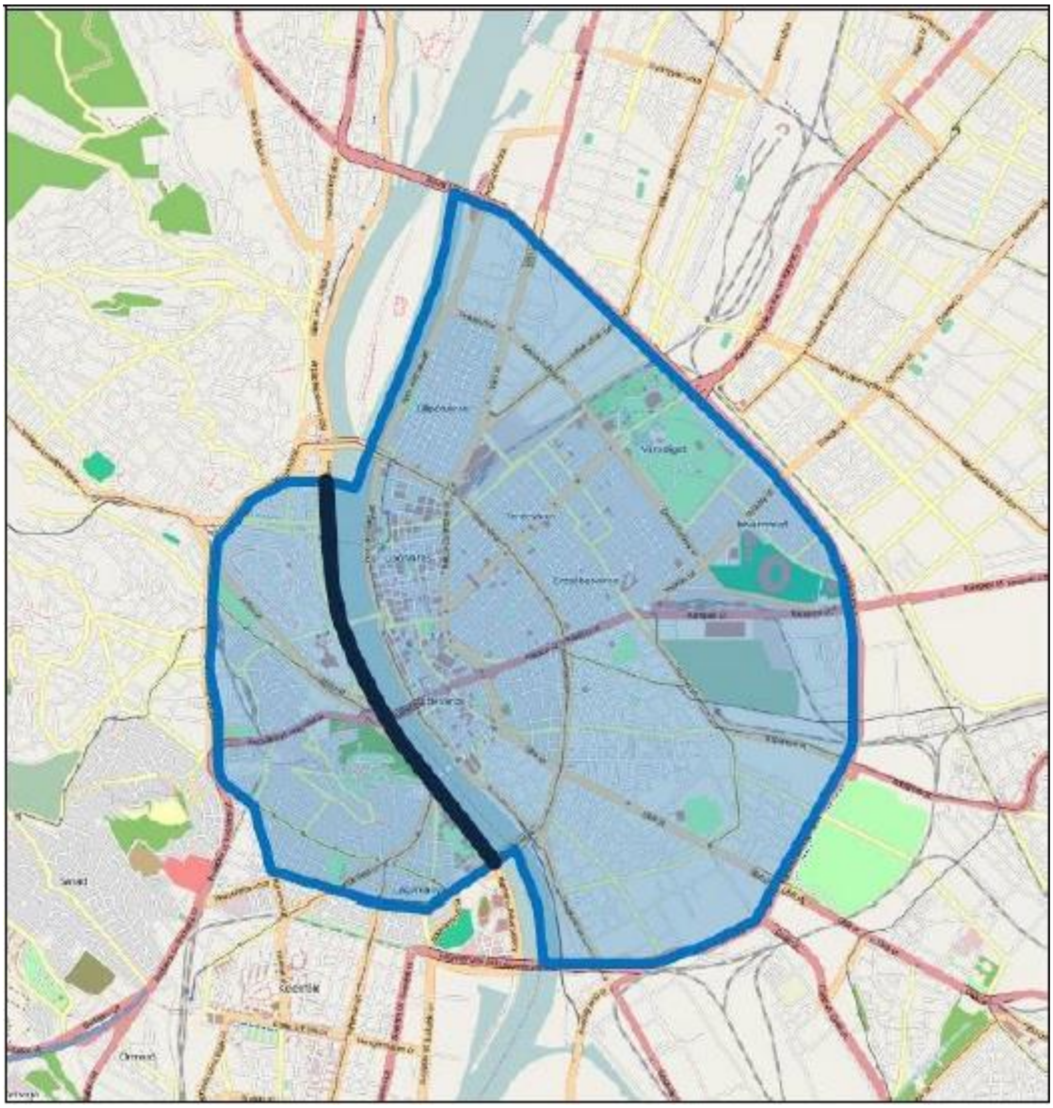


Figure 17. The demarcation of the inner city by the feasibility study of the Budapest congestion charge. The black line along the Danube is the quayside road which is exempt of the congestion charge in the model. Source: (Városkutatás Ltd.. 2009)

According to the above analysis, non-Budapest residents contribute to the 24-31% of inner city commuting traffic. Assuming that similar proportion applies to non-commuting traffic, too, the contribution of Budapest residents to inner city traffic can be estimated to be around 73%[34]. And assuming that the proportion of residents' car traffic is somewhat higher outside the inner city, the share of residential traffic in Budapest can be estimated to be around 20% Assuming that the annual volume of car traffic is 3.576 billion km in Budapest (see Table 3.) and that the number of residents'

[34] It must be noted that the according to David Vitezy, the director of Budapest Development Center, non-residents contribute to peak-hour Budapest car traffic by 50% (Vitezy 2021), so the 77% might overestimate the right share.

cars in Budapest is around 600,000 (KSH 2017), the average car user Budapest resident travel around 4,800 km/year, i.e. 400 km/month within Budapest.

4.3.2 Infrastructure and services

Regarding car use, except some small areas in the inner city, all parts of Budapest can be accessed by car without limitations. Speed is limited to 50 km/h in much of Budapest, except the major multi-laned roads outside the inner city where a speed limit of 60 or 70 km/h is common. However, the average travelling speed is 37 km/h due to frequent junctions and traffic congestion (KSH 2013b).

Fourteen railway lines connect Budapest with its surrounding, four of which (the light rail lines) could be considered as the part of the public transportation system of Budapest, too, i.e. they have frequent stops embedded into the urban structure along their routes (Figure 18.). The other railway lines are basically long-distance lines with couple of stops within Budapest, most of which are rather separated from their surroundings and where only part of the trains stop. Beside the railway lines several bus lines serve the suburbs of Budapest, too, some of which connects directly the inner city with the suburbs. Nevertheless, the majority of them connects the suburbs either with one of the railway lines or one of the metro or tram stops. The passes of the public transportation system entitle the passholders to use the Budapest section of these train and bus lines.

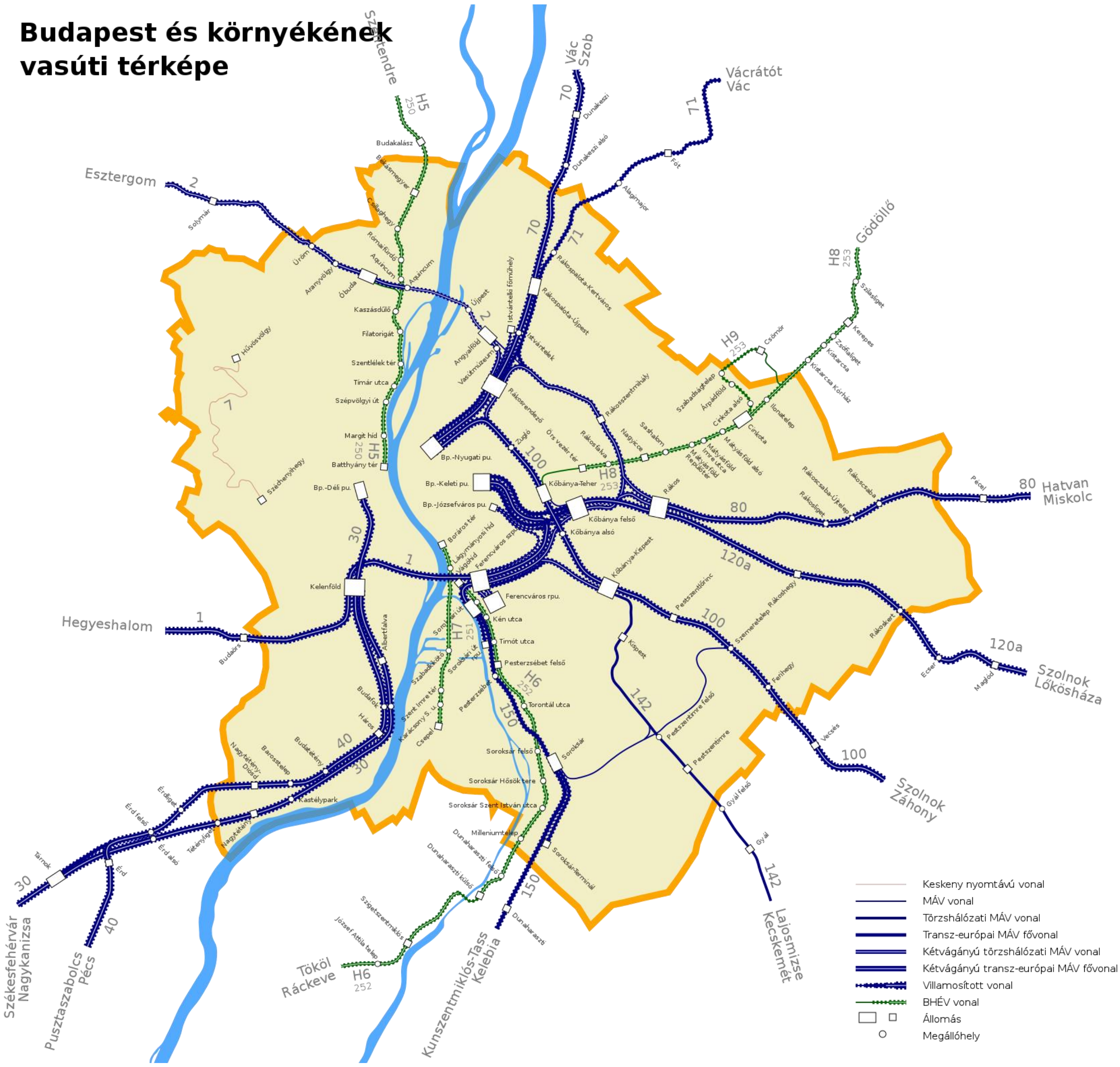


Figure 18. The railway network of Budapest. Source: Wikipedia.org 2021

Budapest itself is served rather well with its own public transportation system, particularly in the inner city, which includes four metro lines, five light railway lines (four of which are the suburban train lines mentioned in the previous paragraph), and many high- and low-capacity tram, bus and trolley lines. The main public transportation lines (e.g. metro lines, major tram and bus lines) are served by rather frequent services: based on the public transportation provider's webpage the vehicles follow each other in every 2-5 minutes during the day on weekdays, while in the late evenings and weekends 5-10 minutes is the common time interval between vehicles (BKK.hu

2020). On the other hand, the time interval on the peripheral lines rarely goes under 10 minutes, even in peak periods, and it can be 30-40 minutes in the weekends (BKK.hu 2020).

The situation is rather different outside Budapest, where the public transportation network is much less dense, and so the distance to the closest public transportation station is likely to be several times larger than in Budapest. Regarding frequency, there is a large variation among the settlements. While in some settlements adjacent to Budapest and along the suburban train lines, vehicles follow each other typically in 10-15 minutes at peak hours (BKK.hu 2020), in some smaller villages located further from Budapest and the main roads, vehicles follow each other typically in 40-60 minutes in peak hours (Menetrendek.hu 2020).

The cycling path network of Budapest metropolitan area is rather limited and deficient, but bike use is allowed on most roads except the largest arterial roads. Many bus lanes in the inner city are also accessible for cycling, and many one-way streets allow bike traffic in both directions.

3.3.2 Individual monetary costs of mobility

This section explores the full and marginal individual monetary costs of car use, public transportation and bike use in the Budapest metropolitan area. Full individual monetary costs refer to all individual monetary costs associated directly or indirectly with a travel, for example acquisition and operation costs (including fuel costs) in case of car use or the cost of tickets or passes in the case of public transportation, but do not include public costs (external costs and subsidies). Marginal individual monetary costs refer to the monetary costs of an additional trip, such as fuel cost and potential parking cost in the case of private car use[35], and the costs of tickets in the case of public transportation. As such, the marginal individual monetary cost is zero in the case of pass-holders, as their individual monetary costs are the same whether they take an additional travel

[35] Though the value of a car (or a bike) decreases even if the car is unused, it decreases more intensively when it is used due to amortization. However, these amortization costs are likely to be so low compared to fuel costs, that they are

or not. In order to allow comparison among the travel modes, the costs for one passenger km are estimated in each case. Marginal individual monetary costs of car use and public transportation are compared in Table 3. at the end of this section.

Car use in the Budapest metropolitan area can be based on personal car, taxi, carsharing or car rental. The following paragraphs presents the economics of these car uses and Table 9. compares the main elements of their expenses. The individual monetary costs per passenger km are calculated assuming a car occupancy of 1.3 that is the average car occupancy in Budapest (Városkutatás Ltd. 2009).[36]

Due to penetration of old (and therefore less expensive) personal cars – the average car is 13.9 years old in Hungary (Bosch Media Service 2018) – the full individual . monetary costs of per km car use in case of private car is on average around 0.25 EUR, but can vary between 0.15 – 0.5[37] EUR (personal experience, Totalcar.hu 2014) that translates into 0.19 EUR/pkm in average (between 0.11 - 0.38 EUR/pkm) full individual monetary cost of personal car use. The marginal individual monetary cost of own car use includes only the fuel and parking costs. The fuel cost is about 0.07 – 0.1 EUR (0.085 EUR in average) per km car use (assuming fuel consumption between 6 and 9 l/ 100 km (6 l in the case of diesel cars), and fuel price 1,15 EUR/l (NAV 2017)) which translates into average 0.05 - 0.08 EUR (0.065 EUR in average) per pkm. In case of LPG, the fuel cost can be as low as 0.048 EUR per pkm (assuming fuel consumption around 8 l/100 km, and fuel price around 0.6 EUR/l). On-street residential parking in Budapest inner city is either completely or practically free, in the latter case a small (5-10 EUR/year) administration fee applies. For non-

ignored in this study. Similarly, the amortization costs are also ignored in the case of bike use and so the marginal expense of bike use is considered zero.

[36]Based on personal experience the average occupancy of a taxi (besides the taxi driver) is likely to be smaller than 1.3. And regarding that rented cars are primarily used for touristic purposes (Blikk.hu 2016), the average occupancy of rented cars are likely to be higher than 1.3. However, due to lack of available data, the average car occupancy is considered 1.3 in each type of car use.

[37] The 0.15 EUR/km individual monetary cost refers to the expense of using a 15 years old small car that had cost 2,000 EUR, loose that value in 5 years, runs on LPG and covered 15000 km a year. The 0.5 EUR/km expense refers to the expense of using a one-year old, middle-range car that had cost around 20,000 EUR, lost 23% of that value after one

residents on-street parking is limited to 3 hours in most part of the inner city and costs 0.5-1.4 EUR/hour depending on the location on weekdays from 8 or 8:30 a.m. till 6 or 8 p.m. However, there are plenty of free parking places in the outer zone of the inner city that are used as quasi P+R facilities. Off-street parking in the inner city costs 0.5-1 EUR/hour and 50-80 EUR/month.

The monetary cost of taxi use is officially set in Budapest (BKK.hu 2021), and it is based on a km-fee of 0.95 EUR (besides a basic fee of 2.2 EUR and a waiting fee of 0.25 EUR/min). The marginal monetary cost equals this expense in the case of taxi use, and it translates into a 0.73 EUR/passenger-km cost assuming that the average occupancy of taxis is 1.3 (besides the taxi driver), too. There are around 5000 taxis in Budapest (24.hu 2017). Other kinds of taxi-like use of cars, such as Uber, are currently not available in Budapest. The monetary costs of carsharing vary between 0.33 and 0.41 EUR/km, depending on the intensity of use (greengo.hu 2019, assuming that the average speed of car use in Budapest is 37 km/h). This translates into 0.26 - 0.32 EUR/pkm, in average 0.29 EUR/pkm individual monetary cost assuming that the average occupancy of shared cars is 1.3, too. The expense of car rental is around 13-50 EUR/day, depending mainly on the type of the car (beerides.com, sixt.hu), which, together with the fuel cost, translates to a 0.17 – 0.42 EUR/km and 0.13 - 0.32 EUR/passenger-km assuming that the car is used for no more than 150 km (above that distance usually extra fees apply) and the average occupancy of rented cars is 1.3. Car rental is mainly used for touristic purposes outside of Budapest (Blikk.hu 2016), so car rental of carless households for urban use is rather uncommon. It must be noted that in any kind of car use when more than 1.3 persons use the car, passenger km expenses are proportionally lower.

Table 9. The individual monetary costs of car use (in EUR), assuming 1.3 persons using the car.

	Full individual monetary costs per pkm	Marginal individual monetary costs per pkm	Comments

year (Penzcentrum.hu 2017) and covered 15000 km a year. Certainly, the full private monetary cost of per km car use can be much higher in the case of highly expensive or rarely used cars.

Personal car	0.11 – 0.38	0.05 -0.08	Parking fee (0.5 – 1.4 EUR/hour) also applies in much of the inner city during the day. Inner city residents park for free within their districts.
Taxi	0.73	0.73	Beside the km fee, basic fee (2 EUR) and waiting fee (0.2 EUR/mins) also apply
Carsharing	0.29	0.29	Registration fee and monthly fee might apply, too.
Car rental (in case of driving 150 km)	0.13 – 0.44	0.13 – 0.44	In case of smaller distances the per km fees can be significantly higher

Regarding public transportation within Budapest, the revenue from selling tickets is about 200 million EUR (BKK 2015), the rest is financed from municipal and governmental resources. As the public transportation volume in 2014 was 5.9 billion pkm (KSH 2017), the average individual monetary cost of public transportation use is about 0.034 EUR/pkm. However, the actual individual price varies to a great extent, as the prices and the intensity of use vary significantly among the users. Table 10. presents the prices of the most commonly used passes and tickets on the public transportation of Budapest and the approximate number of people who used those passes. Other kinds of passes (such as weekly or daily passes) are used by around 10,000 people per day, probably mostly by tourists.

Table 10. The prices of commonly used public transportation passes and tickets in Budapest. Data source: BKK 2016, email communication.

Type of pass	Prices in EUR	Approximate number of users per month in 2014 (per day in the case of tickets, assuming 2 tickets per user)
Monthly pass[38], full price	30-33[39]	378,000
Monthly pass for pupils	11	118,000
Monthly pass for university students	11	112,000
Monthly pass for pensioners under 65	11	78,000

[38] Yearly passes are also available, their prices are 10% lower than the prices of 12 monthly passes. The prices of quarterly passes are equivalent with the prices of 3 monthly passes. Therefore holders of these passes were considered as holders of monthly passes when their numbers were calculated.
[39] Natural persons can buy the monthly ticket for around 30 EUR. However, employers can provide monthly passes to their employees, in this case the price of the monthly pass is around 33 EUR.

Monthly pass for parents with children under 3	11	19,000
Ticket (for one journey)	1 – 1.1[40]	60,000
Free use by - pre-school children - for people over 65	Free	 Maximum 140,000 Maximum 324,000

As Table 10. suggests, the overwhelming majority of public transportation users use monthly passes or travel freely, and very few people use tickets. In addition, a significant part of tickets are likely to be used by tourists as there are more than 35,000 tourists or business visitors in an average day in Budapest (KSH 2017) who are likely to use public transportation by ticket or by daily pass. Therefore, for the overwhelming majority of public transportation users – the pass holders - the marginal individual monetary cost of public transportation is zero. On the other hand, for ticket users, the marginal individual monetary cost is around 0.3 EUR/km[41] in Budapest. Regarding the full individual monetary costs, in the case of pass holders, it depends on how many kilometres the pass holder travels in a month, and so it is likely to vary to a great extent. Nevertheless, as the average pass holder passenger travels 500 km in a month (based on KSH 2017, assuming that pass holders and other people over 65 contribute 90% to the volume of passenger traffic by public transportation), the full individual monetary cost by public transportation is around 0.06 EUR/km for active adults and 0.02 EUR/km for students, pupils and pensioners under 65. In the case of ticket users, the full individual monetary cost equals the marginal individual monetary cost, that is 0.3 EUR/km.

In the neighbourhood of Budapest, travellers can use the metropolitan area services of the public transportation provider of Budapest, the national railway company (MAV) and the national bus company (VOLAN). In each case, the prices of tickets are identical and based on distances (the

[40] Tickets are cheaper for journeys limited to 3 stops in the metro system and when bought in a package of 10. And there are no tickets with discounted price (for student, pensioners, etc.).

[41] The average distance of single public transportation use is around 3.7 km (KSH 2017). As data are not available whether the pass holders and ticket holders differ in this regard, it was assumed that they do not.

cheapest ticket can be used to cover 10 km, then the price changes every 5 km). The full price of 1 km travel is around 0.06 EUR (MAV 2021, VOLAN 2021), students and pensioners under 65 get 50% reduction, pre-school children and people over 65 can travel for free. Monthly passes are available only for given routes, their prices are also identical and based on distances (the cheapest monthly pass can be used to cover 5 km, then the price changes at every 5 km). A monthly pass for covering distances between 25 and 30 km costs around 68 EUR that in the case of 22 two-way travels in a month translates to 0.052 EUR/km (MAV 2021, VOLAN 2021). Students get 90% reduction between their place of residence and their school (MAV 2021, VOLAN 2021). For pass holders, the marginal individual monetary costs of these services are again zero, while for ticket users it is around 0.06 EUR/km.

It must be noted that in the case of employees who work in a settlement other than their place of residence, the employers must refund part of their commuting expenses. In the case of car users, the refund is at least 0.03 EUR/km, while in the case of public transportation users it is the 86% of the cost of relevant passes[42]. Thus when commuting costs are subsidized, the full and marginal individual monetary costs of car use decreases to around 0.16 EUR/pkm and 0.03 EUR/pkm, respectively, and the full individual monetary cost of suburban public transportation decrease to around 0.008 EUR/pkm. The marginal expense of public transportation use does not change as only the pass holders can be refunded.

The individual monetary costs of bike use varies greatly depending on the acquisition price of the bike and the intensity of its use. Assuming a yearly cost of 60 EUR (personal experience) and a distance of 2000 km (that is less than 6 km per day), the full cost of bike use is around 0.03 EUR in the case of bike holders. An annual pass for a community bike costs around 16 EUR (Molbubi.hu 2021) and allows an unlimited number of bike use that does not exceed half an hour, but as

[42] Tickets used for commuting cannot be refunded.

community bikes are likely to be used much less frequently and for smaller distances[43], their per km use is likely to cost around 0.03 EUR, too. For both bike holders and community bike users, the marginal expense of bike use is 0.

Table 11. compares the marginal individual monetary costs per pkm associated with typical two-way trips in the Budapest metropolitan area in the case of inner area residents. The most striking insight of this comparison that the marginal individual monetary cost of occasional use of public transportation (by tickets) is around 4-5 times higher than the marginal individual monetary cost of car use of car holders that is likely to contribute to the more intensive car use of car holders. The difference is similarly large between the individual monetary costs of regular and occasional public transportation use that might frustrate people who would like to use public transportation but only occasionally. There is also a relatively high difference between the individual marginal cost of car use by car holders and car use by carless people that is likely to explain to a great extent why people insist on holding cars even when they use the vehicle infrequently.

Table 11. The average full and marginal individual monetary costs of car, public transportation and bike use within and outside Budapest.

	Full individual monetary cost (EUR/pkm)	Marginal individual monetary cost (EUR/pkm)	Comments
Within Budapest			
Car use by car holders	0.11 – 0.38	0.05 -0.08	parking cost within the inner area: 0.5 - 1.4/hour
Car use by non-car-holders	0.12 – 0.9	0.12 – 0.9	
Public transportation use by pass holders	0.06	0	
Public transportation use by ticket	0.3	0.3	

[43] The average distance per bike use is less than 1.5 km (BKK 2015).

users			
Bike use	0.03	0	
Outside Budapest			
Car use by carholders	0.11 – 0.38	0.05 -0.08	
Car use by non-carholders	0.12 – 0.9	0.12 – 0.9	
Public transportation use by pass holders	0.05	0	Passes are available only for given routes
Public transportation use by ticket users	0.06	0.06	
Bike use	0.03	0	

It must be noted that if monthly individual marginal costs are considered, i.e. the direct costs associated with trips for an additional month, then the difference in costs between car use and public transportation is minimal, as assuming an average 450 vkm made in Budapest (which is the mean of the monthly vkm made by an average resident's car within Budapest and pkm made by an average public transportation user, see above) such costs are 38 EUR in the case of car use (without parking costs) and 33 EUR in the case of public transportation. Therefore, it can be assumed that a car holder person who make trips primarily outside the inner city, where there are no parking costs, perceives no difference between the price of car use and public transportation use.

4.4 Public space distribution in the inner city

Due to the prevailing continuous development, outdoor space is rather limited in the inner city. Most outdoor space is public; these are the streets, squares, parks. Private outdoor space is confined to yards (mostly inner ones but there are some front and backyards, too) of private buildings that are typically accessible only to the users of the buildings (primarily residents or workers) and vacant lots. Most of the yards, however, are rather small, deprived of direct sunlight, and surrounded by sound-sensitive flats; therefore their functions are also limited. Many of the vacant lots are used currently for parking but they are assumed to be built in sooner or later.

Data about urban public space distribution are rare (Gössling et al. 2016), and regarding the whole inner city of Budapest they are unavailable. Nevertheless, the municipality of 7th district provided exact data, thus Table 12. can compare its urban public space distribution with that of Wiehre, one of the oldest quarter of Freiburg that was explored by Gössling et al. (2016).

Table 12. The extents of outdoor areas with different functions in the 7th district of Budapest and in Wiehre, Freiburg (Data source: Email communication 2016 with the municipality of the 7th district[44], Gössling et al. 2016)

	7th district of Budapest		Wiehre, Freiburg	
	m^2	%	m^2	%
Total area	2,090,000	100	1,335,189	100
Road space	152,596	7	157,413	12
Public parking space	72,280	3	38,618	3
Public transportation space (tramlines, bus lanes)	12,500	1	14,809	1
Cycling space	3,800	0	9,931	1
Pedestrian space	139,409	7	98,176	7
Transport infrastructure (including pedestrian space)	380,585	18	318,946	24
Vehicular space	241,176	12	220,770	17
Green space	24,543	1%	200,000[45]	15
Non-vehicular space (pedestrian space and green space)	163,952	8	298,176	24
Share of vehicular space in public outdoor space		60		42
Share of road and public parking		93		89

[44] In 2016 I have contacted all inner city municipalities for getting information about their public spaces, but only the 7th district has provided suitable data.

[45] This number was estimated based on https://en.wikipedia.org/wiki/Green_spaces_in_Freiburg.

space in vehicular space				

Though the share of vehicular space is likely to be lower in other parts of the inner city, regarding that it is around 42% in the continuously developed part of one of the most sustainable city in Europe, it is rather likely that at least half of the outdoor space is devoted exclusively for vehicular transport functions throughout the inner city. This large part of vehicular space is rather obviously the consequence of car use, since road and parking space constitute the 89-93% of vehicular space[46]. That is if more accessibility needs were satisfied by cycling and public transportation, then more public outdoor space could be devoted to non-vehicular space. This means that too intensive car use deprives the inner cities of green and pedestrian space and so reduce the quality of life of inner city residents. It could be argued that inner city residents should be compensated for such a loss in their quality of life. And through non-residents pay parking fees, the revenues from which could be used for compensation, around the 75% of parking places are occupied by residents who park for free (Palatium Studio Kft. and Varoskutatas Kft. 2015).

Nevertheless, public outddor space is occupied not only by parking, but by other activities, too. The most frequent one of such activities is outdoor catering, in the case of which restaurants, pubs or cafes instal terraces on public space. However, form the one hand, the catering companies pay public space usage fees (see details in the next chapter), on the other hand a terrace benefit much more people than parking places of the same size.

4.5 Possibilities of changes

As the long-term perspective of this study entails the possibility of significant changes in Budapest metropolitan areas, it is important to assess the theoretical possibilities of such changes, because if

[46] Certainly, some of the road space is used jointly by public transportation, cycling and car use, but the share of these jointly used roads is low (it is likely to be less than 20% in the 7th district).

these possibilities are very low, then the arguments to study this issue with a perspective of change are much weaker[47]. Therefore this section aims to explore the possibility of a more compact Budapest metropolitan area (as more compact cities tend to rely less on car use) and of a significant shift in the modal split towards public transportation and cycling at the expense of car use.

A more compact Budapest metropolitan area would entail more people living closer to the centre, which seems to be possible based on the following arguements. First, brown-zone sites constitute 5-10 % of Budapest territory (Budapest Mayor's Office 2014), many of which are located within or in the proximity of the inner city (Figure 19.). And even in the inner city there are many smaller brown zones, most of which are vacant lots or ruined buildings, and many of which are currently used as parking plots (Dodelin 2002). The transformation of these sites into residential, office or commercial areas could allow the formation of a more compact metropolitan region. Actually, according to the capital's development document (Budapest Mayor's Office 2011) such a transformation is the official intention of the decision-makers.

The concept of the 15-minute city could also contribute to Budapest being more compact. This concept suggest that cities should consist of city parts, in which large parts of workplaces, education and health institutions, facilities, etc. are available within 15 minutes. This concept might be best facilitated by subcentres of the outer districts of Budapest where many services could be available. As currently these subcentres are rather underdeveloped (see Figure 11.), their development seems to be possible.

[47] E. g. if the if the physical endowments of Budapest were such that the chance of a more compact city were very low, then it would be unnecessary to analyze the choice of place of residence, as anyway people could not live closer to the city centre. Or if the climate or the relief of Budapest were such that cycling were very cumbersome, then it would be unnecessary to analyze the share of cycling in the modal split as cycling could not gain a significant share anyway.

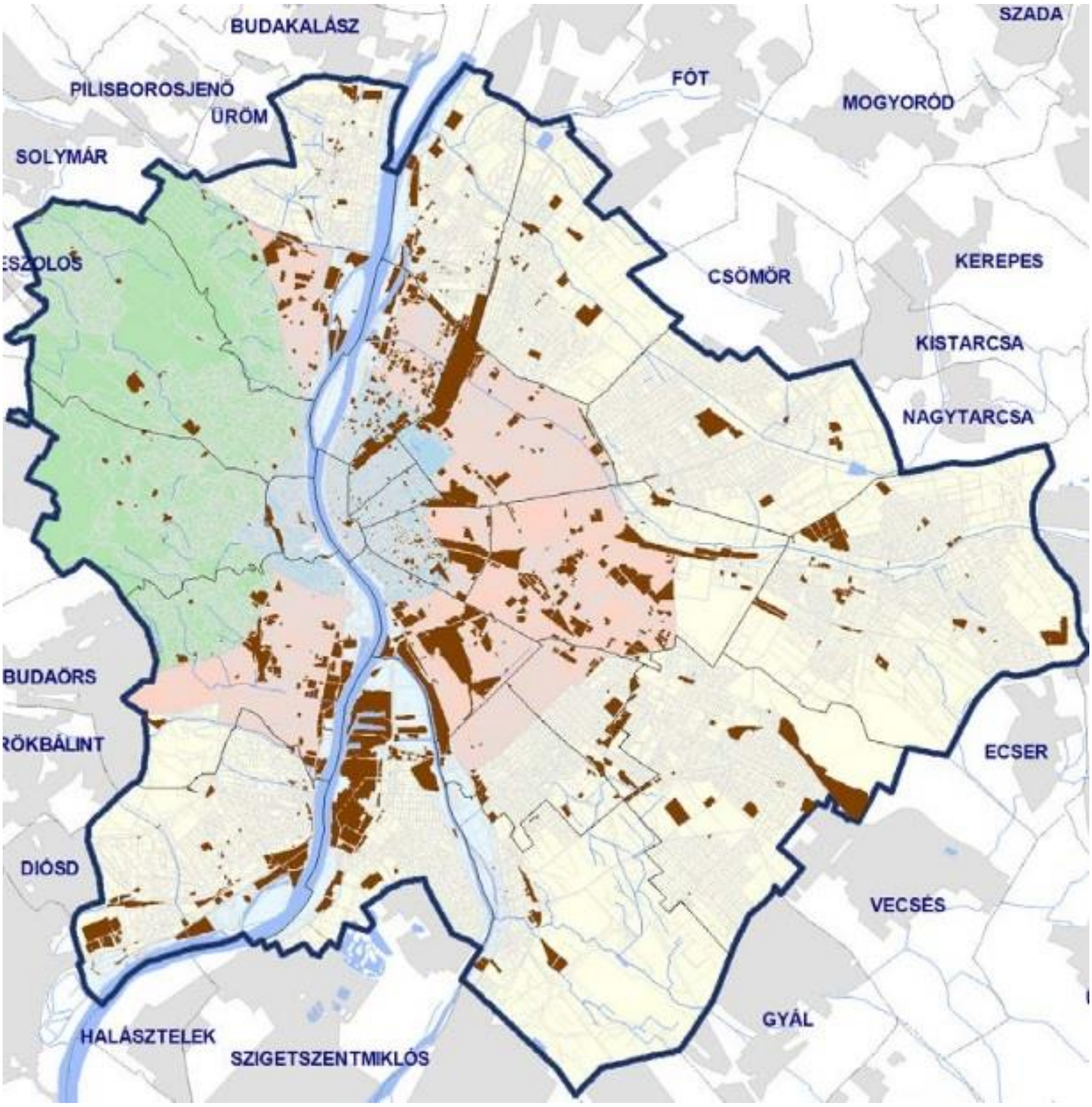


Figure 19. Brown-zones in Budapest. Map source: Mayor's Office 2014

A shift in the modal split towards public transportation and cycling at the expense of car use also seems possible. In theory, as the corridor capacity of above-ground public transportation and cycling many times larger than that of car use (Ribeiro et al. 2012), a shift from car use to public transportation and/or cycling is always possible. In the case of Budapest, the practice also supports the theory as for example in 1990 Budapest's public transportation network performed 14% more passenger-km than in 2016, and in 2000 it performed 4% more passenger-km in a network size of which was 22% smaller than in 2016 (KSH 2017). This suggests that there is no obstacle to carrying more passengers than today. Regarding cycling, according to the European Cycling Federation (ECF 2019), the bike is the most often used transport mode for 22% of Hungarians, and only the Netherlands (36%) and Denmark (23%) precede Hungary in this aspect within the EU. In addition, the flat terrain of Pest and of the areas along the Danube in Buda is rather similar to the flat terrains of the Dutch and Danish large cities. These similarities suggest that theoretically Budapest could develop a cycling scene similar to that of Amsterdam or Copenhagen. Certainly, the hilly areas of Buda is less suitable for cycling, but on the one hand the actually hilly part covers only a small part of Budapest (less than 25%) and accommodates even smaller part of the population, on the other hand their residents have the highest income in Budapest and so affordability of electric bicycles is a less significant barrier of e-cycling than elsewhere. Still, the modal share of cycling is only 2% in Budapest, much lower than in Amsterdam (35%) or in Copenhagen (49%) (ECF 2019).

4.6 Summary

This chapter has presented those characteristics of Budapest metropolitan area that are likely to influence the extent of car use in the inner city. The most important insights are the following:

1. Budapest is a rather monocentric city, the office workplaces, the education and health institutions, the cultural facilities all concentrate in the inner city to a rather great extent. In addition, the inner city of Budapest is the centre not only of Budapest metropolitan area, but that of the whole country in terms of infrastructure, governance, and economic, educational and cultural performance.
2. The inner city of Budapest is rather densely populated, its density is almost three times higher than the outer city of Budapest.
3. The closer a location is to the centre, lower the proportion of children is, smaller the average household size is, lower the penetration of cars is, higher the share of public transportation is.

4. The individual monetary costs of motorized transport are ower due to the lower cost of imported second-hand cars, the free residential parking and the heavily subsidized public transportation and commuting. These lowered individual monetary costs are likely to encourage urban sprawl.

5. Due to the high density of population, workplaces, facilities in the inner city, the transport requirements are enormous. Due to urban sprawl and the affordability of car use, a large part of transport requirements are met by car use. The too intensive car use then consumes around half of the public outdoor space in the inner city.

6. There is no exclusive barrier of a more compact Budapest and less intensive car use. 5-10% of the territory of Budapest is brown zone, large part of which could be transformed into housing developments. Large part of car use could be substituted by public transportation use is possible even in the current level of public transportation and cycling.

7. The marginal individual monetary costs of car use strongly favours car ownership over carsharing, and the marginal individual monetary costs of public transportation strongly favours use by monthly pass over use by ticket.

8. In case of car holders occasional use of public transportation is discouraged by the relatively large difference between the marginal monetary costs of car use and occasional public transportation use, and this is likely to entail more intensive car use.

9. The overwhelming majority of suburban households have cars. As there is only a minimal difference between the marginal individual monetary cost of car use in the case of car holders and the marginal individual monetary cost of public transportation use (except on routes, at which the user hold a pass), and as the public transportation service is rather rare outside Budapest, the modal share of car use is much higher in the case of trips within the suburban zone of Budapest compared to the modal split within the city of Budapest.

5 QUANTIFICATION OF MOBILITY RELATED SUBSIDIES

As was presented in the methodology, the analysis of the mobility-related subsidy distribution requires first the exploration of those subsidies. In addition this chapter also aims to shed light on pro-car regulation that, similarly to car use subsidies, encourages car use. Finally, the chapter also aims to show the impact of motorized transport incentives on inner city car domination.

5.1. Exploration of mobility related subsidies

This section attempts to calculate the quantifiable per use (per passenger km in general, and per year in the case of consumed public parking space) subsidies that are the generic external costs of motorized transport, the $PM_{2.5}$ pollution-related health costs, the costs of consumed public space, the direct subsidies of public transportation, and the commuting subsides.

5.1.1 Subsidies related to the generic external costs of motorized transport

The generic external costs of motorized transport include external costs of climate change, external costs of soil and water quality reduction, land use and infrastructure, traffic infrastructure maintenance, resource consumption, accidents and noise pollution. In this research, I will use the values determined by the study of Gössling et al. (2019) that is based on reviewing several Cost-Benefit Analyses. In their study, these external unit costs amount to 0.101 EUR/pkm in the case of car use. Similaryl, the handbook of external costs of transport by van Essen (2019) estimated a rather similar value (0.113 EUR/pkm) for a similar range of external unit costs, though the two studies attributed rather different values to each type of external unit costs.

As was suggested in the methodology, in the case of public transportation these external unit costs are assumed to be equal to the third of the unit cost of car use (van Essen 2019) that is 0.034 EUR/pkm.

Estimating the annual car traffic volume in Budapest to be 3.576 billion vkm/year (Stratégia Konzorcium 2013), and assuming the average car occupancy to be 1.3 (Városkutatás Ltd.. 2009), the pkm volume of car traffic is estimated to be 4.649 billion pkm/year and so the generic external costs of car use in Budapest are estimated to be 470 million EUR/year. As the pkm volume of public transportation is around 5.868 billion pkm/year (KSH 2017), the generic external costs of public transportation is estimated to be 200 million EUR/year.

5.1.2. Subsidies related to the health costs of air pollution

I estimated the overall health cost of air pollution on the basis of the study of de Bruyn & de Vries (2020) that was commissioned by a coalition of public interest NGOs from 10 European countries. The study estimated the overall annual cost of air pollution in Budapest as 3.272 billion EUR. A somewhat similar value was estimated by the Aphekom project commissioned by the EU that estimated that the annual mortality harms caused in Budapest by $PM_{2,5}$ pollution – the most significant in terms of air pollution harms (OECD 2014, Sommer et al. 2000) - are in the range of 4,1 - 4,9 billion EUR. (Paldy and Bobvos 2012). Moreover, these estimations are also in line with the calculation of the OECD study (2014), which identified 19 billion EUR economic cost from ambient air pollution for the whole Hungarian population (the population of Hungary is about 6 times larger than that of Budapest, but the air pollution situation of Budapest is worse than the air pollution of Hungary). In order to avoid overestimation and to use the latest data, I estimated the overall cost of air pollution as 3.272 billion EUR.

For estimating the contribution of local road traffic to air pollution, the contribution of road traffic to $PM_{2.5}$ pollution is used as the external cost of $PM_{2.5}$ pollution dominates the external costs of air pollution. The contribution of road traffic to $PM_{2.5}$ pollution of urban areas is a highly contested issue for several reasons (Pant & Harrison 2013, HEI panel 2010). First, besides road traffic, combustion of solid fuels, industrial activity and $PM_{2.5}$ emitted elsewhere and carried to the urban area by wind are also significant sources of $PM_{2.5}$ pollution. Secondly, besides fuel combustion and abrasion of tyres and breaks, road traffic also contributes to $PM_{2.5}$ pollution by the abrasion of pavement and the re-suspension of road dust, though to a smaller extent than in the case of PM_{10} pollution (Pant & Harrison 2013). Still, estimates exist. According to Querol et al. (2004) local road traffic accounts for 40-60% of $PM_{2.5}$ concentrations. Assuming that the natural input to $PM_{2.5}$ is around 10% (Querol et al. 2004, Belis et al. 2013), the contribution of road traffic to $PM_{2.5}$ pollution is at least 44-67%. The review of Belis et. al. (2013) suggests a similar contribution range for the overall contribution of traffic (33-67%) if half of the secondary sources is allocated to traffic[48]. Regarding Budapest, there is no available data about the sources of $PM_{2.5}$ pollution. However, regarding PM_{10} pollution, road traffic is estimated to account for 79% of its concentration (Városkutatás Ltd.. 2009). Based on these research findings, it is safe to assume that road traffic accounts for around 50% of the $PM_{2.5}$ pollution in Budapest. Within road traffic, the share of passenger and freight transport in the contribution to $PM_{2.5}$ pollution is estimated to be 70:30[49] based on the study of Városkutatás Ltd. (2009). Therefore the contribution of car and bus traffic to the air pollution-related health costs in Budapest is estimated to be 70%of the half of the 3.272 billion EUR/year, i.e. 1.145 billion EUR/year.

The annual car traffic volume in Budapest estimated to be 3.576 billion vkm/year (Stratégia Konzorcium 2013), and the average car occupancy is estimated to be 1.3 (Városkutatás Ltd.. 2009), and so the annual pkm volume of car traffic is estimated to be 4.649 billion. The annual bus traffic volume is estimated to be 89 million[50] vehicle-km/year (KSH 2017), and the average bus ridership is estimated to be 28.3 (KSH 2017), and so the annual pkm volume of bus traffic is estimated to be 2.519 billion. The air pollution emission of a bus is estimated to be 6 times higher than that of a car (Városkutatás Ltd. 2009). Thus the air pollution related health costs of car and bus traffic are around

[48] According to the study, the sources of secondary $PM_{2.5}$ pollution are combustion of fossil fuels, particularly diesel, farming activities, sea salt, gypsum dust, etc. As farming activities and sea salt are unlikely to play a significant role in Budapest, the main sources of secondary $PM_{2.5}$ pollution are likely to be traffic and heating.

[49] The study of Parking Ltd. estimated the 70:30 shares for NOx. It is assumed that similar shares apply in the case of $PM_{2.5}$ pollution.

[50] There are no available data of the bus traffic volume of other bus services (long-distance buses, tourist buses, sightseeing buses, etc.), therefore it was ignored in this study.

996 million and 149 million EUR, respectively. Thus the pkm unit cost of air pollution of car and bus use are 0.214 and 0.059 EUR, respectively.

As an average Budapest resident spends much more time in Budapest in a year, particularly outdoors, than visitors (commuters from outside Budapest, tourists, etc.) the overwhelming part of these health harms apply to Budapest residents. Assuming that 90% of health harms applies to Budapest residents, the average Budapest resident is compelled to endure around 596 EUR/year[51] (1 145 000 000) x 0.9 / 1 729 000 = 596) health harm associated with car and bus traffic. Certainly, the health harms of an average resident living in the inner city or along busy roads, are likely to be significantly higher, while residents living in traffic-calm suburbs are likely to be exposed to lower health harms.

5.1.3. Parking subsidies

Table 13. presents the annual fees of public space use in the 5th district of Budapest, which is a district with limited residential, but ample administrative, touristic and business functions (a kind of Central Business District), in the 7th district, which is a mainly residential district, part of which has recently become a major entertainment quarter of Budapest, and in the areas managed by the capital that are scattered around in the inner city.

Table 13. The yearly price in EUR of 10 sq meters public outdoor space use in two inner districts of Budapest and in areas managed by the capital. Data sources: decrees 31/2008 and 15/2013 of the Municipality of the 5th district, decrees 59/2013 and 22/2013 of the Municipality of the 7th district, decrees 30/2010 and 3/2013 of the Municipality of Budapest Capital.

Types of private use of public outdoor space	5th district	7th district	Areas managed by the capital
Terrace of catering facilities (usually monthly fees apply, it depends on the location within the district)	2243-3743	1911 – 6879	2020 - 3615

[51](1 145 000 000) x 0.9 / 1 729 000 = 629

Car parking for non-residents for a year (hourly parking fees x 2500 (3000))[52]	2484 – 5016	1393 – 4204	0 – 4204

As it was presented in the methods chapter, the mean of the lowest[53] fee of terraces (1911 EUR/year) and the lowest parking fees for non-residents (1393 EUR/year) were considered as the unified annual cost of a parking space in the whole inner city in this study. That is 1652 EUR/year.

The official residential annual parking fee in Budapest is 250 times the hourly parking fee (decree 30/2010 of the Municipality of Budapest capital) that range between 0.557 EUR/h and 1.672 EUR/h. Thus the annual fees range between 139 and 418 EUR that are already rather discounted fees. However, the district municipalities provide 100% discount from these official prices for at least one car per household, but the 7th district of Budapest provides this discount to unlimited number of cars.

There are around 50,000 public parking places in the inner city of Budapest (Budapest Mayor's Office 2011). Assuming that 75% of these parking places are occupied by residential parking (Palatium Studio Kft. and Városkutatás Kft. 2015), the parking subsidies in the inner city amount to 62 million EUR/year.

5.1.4. Public transportation subsidies

The monetary costs of operating public transportation in Budapest was about 580.5 million EUR in 2014 and the revenue from selling tickets is about 188.2 million EUR (BKK 2015). The remaining 392.3 million EUR is financed jointly from the public resources of Budapest and Hungary and so are considered as public subsidy[54]. As the public transportation volume in 2014 was 5.613 billion

[52]It should be noted that on-street parking in Budapest inner city is free at nights and weekends and so the cost of parking at these periods are not reflected in Table 1. If these costs were considered then the subsidies of parking space consumption would be even higher.

[53] Closer a terrace or a parking place to the city center are, the higher their fees.

[54] The public transportation system of Budapest requires other resources, too, e.g. the costs of vehicles and infrastructure maintenance, which are usually financed from state resources. However, due to the limited data availability these financial resources were ignored in this study.

passenger-km (KSH 2017), the full monetary costs of public transportation is 0.103 EUR/pkm and the monetary subsidy of public transportation use is about 0.07 EUR/pkm.

5.1.5. Commuting subsidies

As was presented in the methodology chapter, 98% of obligatory provided commuting subsidies are considered as public commuting subsidies in this study. In the case of car user commuters, the obligatory provided commuting subsidy is 0.029 EUR/km (Personal Income Tax Statute 1995, 25. §, Government Decree 39/2010, 4. §); therefore, the car use commuting subsidy is estimated to 0.028 EUR/km. In the case of commuters by public transportation, the obligatory provided public subsidy is the 86% of the price of a monthly pass between the settlements of residence and workplace. As was presented in chapter 3, the km price of a monthly pass is around 0.052 EUR/km; thus the commuting subsidy was estimated to be 0.045 EUR/km.

Based on 2011 census data provided by the KSH ,around 131,000 and 180,000 people commute to Budapest or from Budapest altogether, by car and by public transportation, respectively. Assuming the average subsidized one-way commuting distance is 30 km, and 70% of car users receive the obligatory commuting subsidies (while the other receive no such subsidies), the annual amount of commuting subsidies is around 41 and 128 million EUR in the case of commuting by car use and public transportation, respectively.

5.1.6 Summary of subsidies

Table 8. summarizes the public subsidies per pkm for different travel modes. The public subsidies associated with parking space use are not presented in this table as they are unrelated to the distance travelled by cars.

Table 14. The subsidies of car use and public transportation use in Budapest.

	Car use (million EUR/year)	Public transportation use (million EUR/year)	Car use (EUR/pkm)	Public transportation use (EUR/pkm)

Subsidies related to generic external costs	470	200	0.101	0.034
Subsidies related to external costs of air pollution	996	149 (only in case of bus)	0.214	0.059 (only in case of bus)
Public transportation subsidies		188		0.07
Commuting subsidies (in the case of commuters of the inner city	41	128	0.028	0.045
Parking subsidies of inner city residents	62		1652 (EUR/year)	
Total	1,569	665		

As it was presented in Chapter 4, the average individual monetary costs of car use are around 0.19 EUR/km, and the average individual marginal monetary costs of car use is normally around 0.065 EUR/km. That is the public subsidies reduce the average overall operating costs of car use by 66% and 33% within and outside Budapest, respectively. The parking subsidies reduce the inner city residential parking costs by 100%. As the individual monetary costs of public transportation by monthly pass in Budapest is around 0.33 EUR/km, the public subsidies reduce the expenses of public transportation within Budapest by around 78-83% (depending on whether the passenger uses a bus or other vehicles, etc.). In case of students and pensioners, the reduction exceeds 90%. And as the people over 65 are entitled to free use of public transportation, in the case of their public transportation use, the subsidy is 100%. And due to the commuting subsidies, commuters by car and commuters by public transportation do not have to pay even the subsidized mobility prices. This means that in the case of car use, commuters cover only 55% of the costs of their car use outside Budapest, while without commuting subsidies they would cover 67% of it. And even if only the generic external costs are attributed to the full costs of suburban public transportation, then commuters by public transportation cover only 8.5% of the commuting costs (the individual monetary costs of suburban commuting by public transportation is 0.008 EUR/pkm, while without commuting and generic subsidies they were 0,06+0.034=0.094 EUR/pkm).

5.3 The impact of public subsidies

As was presented above, the most straightforward mobility-related subsidies alone reduce the overall costs (prices) of Budapest related motorized mobility by 66-86% within Budapest and 33-90% outside Budapest. As motorized transport facilitate residing in suburban houses and quick, comfortable and flexible access to different destinations, many people gain satisfaction from consuming more motorized transport. Thus even the basic economic correlation between price and demand suggests, that such a substantial price reduction is likely to contribute to a much greater demand for motorized transport. Such a greater deman then entails greater travel distances and a less compact metropolitan area, in which the competitiveness of car use rises compared to public transportation. Nevertheless, the quantification of the full impact of the subsidies would have required complex modelling due to the far-reaching, intertwining and uncertain effects of subsidies and thus was beyond the scope of the project. Still, the research and insights from other resources allowed a limited assessment of this impact. Thus in this section, three partial assessments are presented.

1. The study of Városkutatás Ltd. (2009) assessed the effect of a congestion charge of 2.55 EUR levied on each car entering the inner city. According to the model applied in the study, this charge would result in a 53% reduction in the number of cars entering the inner city. If the charge of 2.55 EUR is regarded as a reduction of car used subsidies, then it can be claimed that subsidizing each car trip by 2.55 EUR increases the number of cars in the inner city by around 113% (100%/47%). Assuming that the average distance made by the cars entering to the inner city is 8 km (the radius of the inner city is around 4 km), assuming an occupancy rate of 1.3 and estimating the per km unit subsidy as 0.315 EUR/pkm (Table 14.), each car entering the inner city entail a subsidy of 0.315 x 8 x 1.3=3.28 EUR. It can be assumed that if car users had to cover all these subsidies, the number of cars entering the inner city would decrease even to a greater extent.

2. I initiated an article[55] (Zubreczki 2016) on index.hu – one of the most popular news portal in Hungary at the time – on 8th of May, 2016 that raised the possibility of introducing the following scheme: each inner city resident receives around 160 EUR/year as a compensation for health harms, a monthly on-street parking fee of 32 EUR/month is introduced, and a daily charge of 2.55 EUR is applied to any car use in the inner city. The article included a survey question about the expected reactions of inner city residents to introducing the scheme presented above. Figure 20. displays the distribution of the responses of 2010 respondents to this survey question.

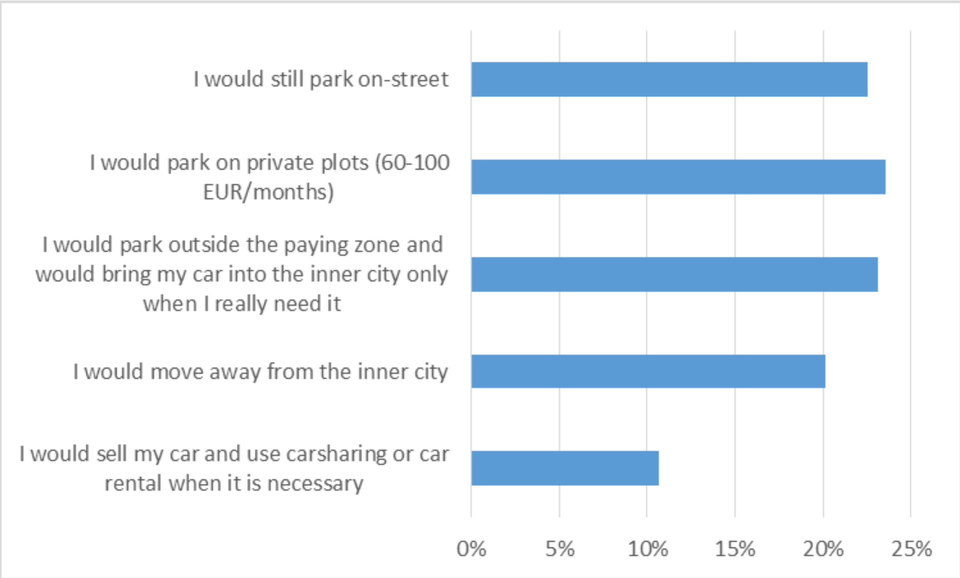


Figure 20. The distribution of claimed reactions if the scheme presented in the text were introduced to Budapest inner city.

Though there is no information about the respondents, the distribution of answers suggests that even these partial reduction of car use subsidies would reduce the extent of on-street residential parking, or conversely, current car use subsidies are likely to increase on-street residential parking to a very great extent.

[55] The article was based on the result of the research survey and was suggested by the author.

3. One question of the research survey inquired about the most frequently used travel mode for commuting. As students in Budapest are eligible to buy monthly public transportation passes at a 65% discount, this question allowed to assess the impact of this discount. While the proportion of students between 18-25 who commute by bike is around 6% (among those who commute by car, public transportation or bike, N=70), the proportion of non-students between 18 and 25 who commute by bike is around 20%, N=46). Though the sample sizes are rather small and so regarding the whole population between 18 and 25 the difference between students and non-students might not be so large, the proportion of bikers is significantly higher in the case of non-students than in the case of students (Chi-square=5.352, df=1, asymp. sig.<0.021). It can be assumed that the substantial public transportation subsidies students receive contribute to their lower cycling rate. That is, the student subsidies of public transportation use are likely to increase public transportation use at the expense of cycling. Then the increased public transportation use might entail greater energy consumption and/or might reduce the attractiveness of public transportation through the phenomenon of overcrowding. Certainly, it can be claimed that on the other hand reducing public transportation subsidies might encourage some people to switch from public transportation to car use. But if car use subsidies are reduced as well, then the reduction of public transportation subsidies are unlikely to encourage public transportation users to switch to car use.

6 Distribution of mobility-related subsidies

6.1. Current mobility related subsidy distribution

This section explores this distribution of mobility-related public resources among people living and/or working in Budapest inner city. The following groups were identified:

1. Suburban commuters by car: The average individual of these group resides 30 km away from his or her workplace in the inner city, use his or her private car to cover the 30 km commuting distance, including 13 km[56] within Budapest, parks in a private parking space. In a year, he or she commutes 220 times covering 13,200 km, including 5,720 km within Budapest and his or her commuting is subsidized. He or she travels additional 6,000 km outside Budapest by car. So in a year, he or she travels by car 5,720 km in Budapest, and 19,200 km[57] in total. According to the estimations based on the census, there are around 25-40,000 commuters who typically commute by private car from outside Budapest to the inner city.

2. Suburban commuters by public transportation: The average group member resides 30 km away from his city centre workplace, commute 25 km by train to a central train station, then take a 5 km ride on public transportation daily and travels additional 1,200 km/year with public transportation for other purposes with a monthly pass (363 EUR for a year). In a year, he or she commutes 220 times, his or her commuting is subsidized. So in a year, he travels 11,000 km by train, and 3,400 km by urban public transportation, 40% of which by bus (according to KSH (2017) the 40% of all public transportation pkm is made by bus in Budapest). He or she travels additional 6,000 km by car outside Budapest. According to the estimations based on the census there are around 55-70,000 commuters who typically commute by public transportation from outside Budapest to the inner city,

[56] If Budapest is regarded as a circle, then its radius is around 13 km.

[57] Based on Bosch Media Service (2018) and Stratégiai Konzorcium (2013) the average mileage of a personal car in Hungary is 10-17,000 km, but commuters by car are likely to travel more by car than others.

and according to the data presented in Table 2. at least 90% of them (around 50-63,000 persons) have a car.

3. Outer city residents who commute to the inner city by car: He or she resides in the outskirt of Budapest, work in the inner city and commute by car (10 km) 220 times a year and travels additional 3,000 km/year in Budapest and 6,000 km/year outside Budapest for other purposes. So in a year, he or she travels by car 7,400 km in Budapest, and 13,400 km in total. According to the estimations based on the census, there are around 30,000 commuters who typically commute from the outer city to the inner city by car.

4. Outer city residents who commute to the inner city by public transportation and have a car: She commutes from the outer city to the inner city by public transportation (10 km) 220 times a year and travels additional 1,200 km/year for other purposes with a monthly pass (363 EUR for a year). So in a year, she travels 5,600 km by public transportation, 40% of which by bus. In addition, he or she travels by car 3,000 km/year in Budapest and 6,000 km outside Budapest, i.e. 9,000 km in total. According to the estimations based on the census, there are around 135,000 commuters who typically commute from the outer city to the inner city by public transportation, and based on the data of Table 2. around 75% of them (around 100,000 persons) have a car.

5. Outer city residents who commute to the inner city by public transportation and do not have a car: She commutes from the outer city to the inner city by public transportation (10 km) 220 times a year and travels additional 2,400 km/year for other purposes with a monthly pass (404 EUR for a year). So in a year, she travels 6,800 km by urban public transportation, 40% of which by bus. According to the estimations based on the census, there are around 135,000 commuters who typically commute from outside the inner city to the inner city by public transportation, and based on the data of Table 2. around 25% of them (around 27,000 persons) do not have a car.

6. Inner city residents who commute to the inner city by public transportation and have a car: He or she resides and works in the inner city, parks in a public parking space, commute by public

transportation (5 km) 220 times a year, and travels an additional 800 km/year by public transportation with a monthly pass, so in a year she travels 3,000 km by public transportation (20% of it on a bus, as public transportation in the inner city is primarily based on the underground, tram or trolley bus). She uses the car mainly on the weekends and covers 7,500 km in a year, including 1,500 km/year within Budapest. According to the estimations based on the census and the survey, there can be around 80,000 inner city residents who work in the inner city and typically commute mainly by public transportation, and based on Table 2. less than half of them (around 40,000 persons) have a car.

7. Inner city residents who commute to the inner city by public transportation and do not have a car: He or she resides and works in the inner city, commute by public transportation (5 km) 220 times a year, and travels an additional 1,200 km/year by public transportation with a monthly pass, so in a year she travels 3,400 km by public transportation (20% of it on a bus, as public transportation in the inner city is primarily based on the underground, tram or trolley bus). According to the estimations based on the census and the survey, there can be around 80,000 inner city residents who work in the inner city and typically commute mainly by public transportation, and based on Table 2. around half of them (around 40,000 persons) do not have a car.

8. Inner city residents who commute to the outer city by public transportation and have a car: He or she resides and works in the inner city, parks in a public parking space, commute by public transportation (10 km) 220 times a year, and travels an additional 800 km/year by public transportation with a monthly pass, so in a year she travels 5,200 km by public transportation (40% of it on a bus). She uses the car mainly on the weekends and covers 7,500 km in a year, including 1,500 km/year within Budapest. According to the estimations based on the census and the survey, there are around 45,000 inner city residents who work in the inner city and commute typically by public transportation, and based on Table 2. less than half of them (around 22,500 persons) have a car.

9. Inner city residents who commute to the outer city by public transportation and do not have a car: He or she resides and works in the inner city, commute by public transportation (10 km) 220 times a year, and travels an additional 1,200 km/year by public transportation with a monthly pass, so in a year she travels 5,600 km by public transportation (40% of it on a bus). According to the estimations based on the census and the survey, there can be around 45,000 inner city residents who work in the inner city and commute typically by public transportation, and based on Table 2. around half of them (around 45,000 persons) do not have a car.

10. Inner city residents who commute to the outer city by car: He or she resides in the inner city, parks in a public parking space, commute by car (10 km) 220 times a year, and travels an additional 2000 and 6000 km/year by car within and outside Budapest, respectively so travels 6,400 km/year within Budapest, and 12,400 km/year in total. He or she uses public transportation with tickets (so his or her public transportation use is not subsidized). According to the estimations based on the census, there are around 15,000 inner city residents who typically commute to the outer city by car.

11. Inner city residents who commute to the suburbs by car.

The average person of this group resides in the inner city, parks in a public parking space, commute by car (25 km[58], including 13 km within Budapest) 220 times a year, receives commuting subsidies and travels an additional 2000 and 6000 km/year by car within and outside Budapest, respectively, so travels 7,720 km/year within Budapest, and 19,000 km/year in total. He or she uses public transportation with tickets (so his or her public transportation use is not subsidized). According to the estimations based on the census, there are around 10-12,000 inner city residents who typically commute to the suburbs by car.

12. Inner city residents who commute and travels mainly by bike.

[58] It can be assumed that long outward commuting is shorter than long inward commuting, as suburban workplaces are likely to be more concentrated in he proximity of Budapest than places of residence.

The average individual in this group uses the public transportation with tickets (so his or her public transportation use is not subsidized), and travels by car 1,200 km/year, including 200 km within Budapest. Based on the first questionnaire survey, there 10,000 inner city residents for whom the primary travel mode is cycling.

13. Inner city pensioners who have a car.

The average individual in this group is over 65, parks in a public parking place, travels 1,200 km/year by public transportation (20% of it on bus) and travels around 3,000 km/year by car, including 1,200 km/year within Budapest. According to Table 2. and Table 3., there are around 80,000 pensioners over 65 living in the inner city and based on the first questionnaire around half of them (40,000) have a car.

14. Inner city pensioners who do not have a car.

The average individual in this group is over 65, travels 2,400 km/year by public transportation (20% of it on bus). According to Table 2. and Table 3., there are around 80,000 pensioners over 65 living in the inner city and based on the first questionnaire around half of them (40,000) do not have a car.

15. Inner city students who do not have a car and study in the inner city[59].

The average individual of this group commute to his or her place of education by public transportation (5 km) 180 times a year, and travels an additional 1,200 km/year by public transportation with a student monthly pass, so in a year he or she travels 3,000 km by public transportation (20% of it on a bus, as public transportation in the inner city is primarily based on the underground, tram or trolley bus). Assuming that 25% of the around 100,000 university students reside in the inner city, and the 80% of them do not have a car, the size of this group is around 20,000.

16. Outer city students who do not have a car and study in the inner city.

The average individual of this group commute to his or her place of education by public transportation (10 km) 180 times a year, and travels an additional 2,400 km/year by public transportation with a student monthly pass, so in a year he or she travels 4,200 km by public transportation (40% of it on a bus). Assuming that 70% of the around 100,000 university students reside in the outer city and the 80% of them do not have a car, the size of this group is around 55,000.

As the total number of inner city residents (around 380,000), commuters to the inner city (around 260,000) and university students who live outside the inner city (around 75,000) is around 715,000, the above groups (altogether around 583,000) constitute more than 80% of those who live in the inner city or frequently visit it. Examples of people who are not included in the above groups are inner city residents who commute by bike and have a car, inner city residents who commute to the suburbs and do not have a car, etc. most of whom constitute groups that are likely to be smaller then 10,000 people. And children are also missing from this analysis, due to the lack of data about their mobility patterns. Nevertheless, most children are likely to travel much less than adults.

Table 15. summarizes the estimated mobility patterns of the above groups and Table 16. presents the quantified amounts of subsidies in the case of average persons of each groups. Groups are signified by combination of letter codes the definition of which are presented in the captions of the tables.

Table 15. Mobility patterns of the groups.
Definition of codes:
1st letters: place of residence: S – suburbs, O – outer city, II, IO, IS – inner city residents who work in the inner city, in the outer city and in the suburbs, respectively,
2nd letters: way of commuting: C – car use, PT – public transportation, Cy – cycling
3rd letter: occupation: W – worker, P – pensioner, S – student
+/-: have a car / do not have a car

Groups	All car use (km)	Car use in Budapest (km)	All public transportation use (km)	Public transportation in Budapest (km)	Bus use in Budapest (km)	Suburban commut-ing (km)	Residential parking (+ / -)	Group size (in persons)
1. S, C, W, +	19,200	5,720				13,200	-	32,000

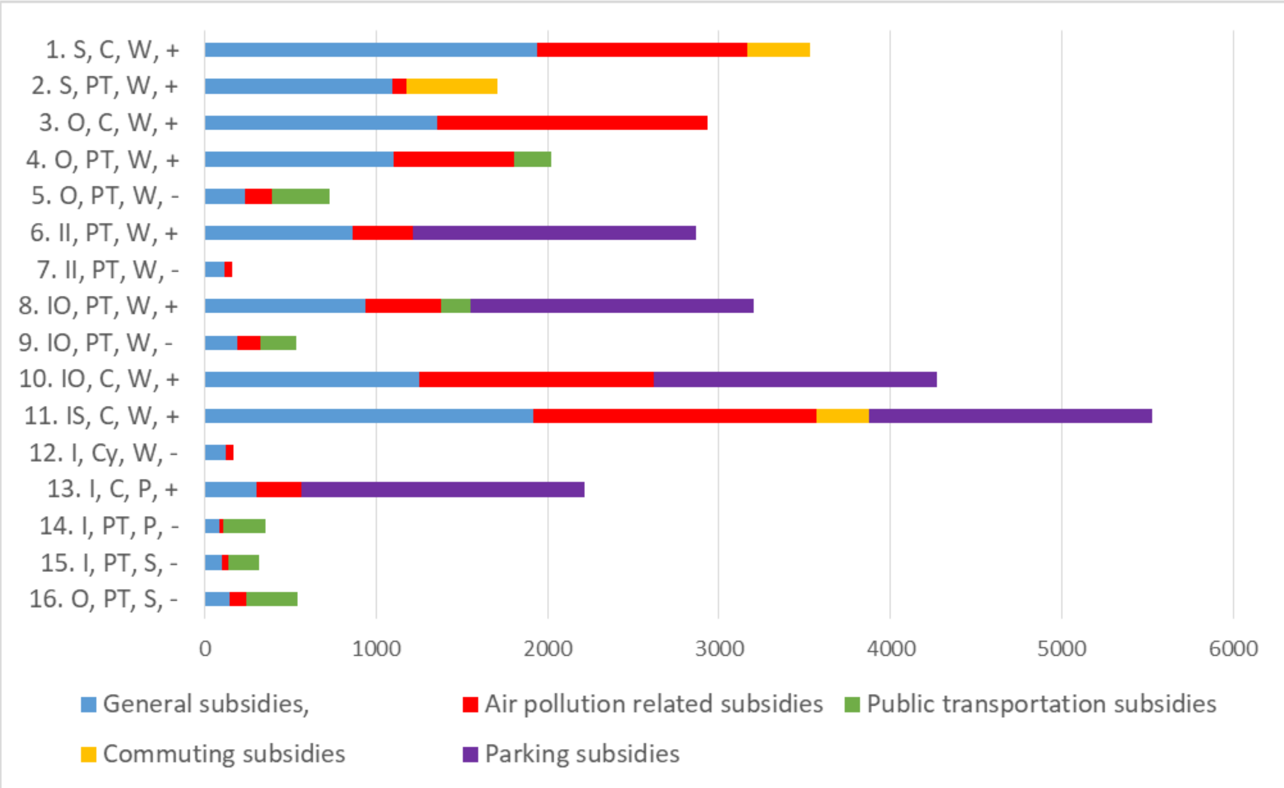
59 Most universities are located in the inner city.

2. S, PT, W, +	6,000		14400	3,400	1,360	11,000	-	55,000
3. O, C, W, +	13,400	7,400					-	30,000
4. O, PT, W, +	9,000	3,000	5,600	5,600	1,120		-	100,000
5. O, PT, W, -			6,800	6,800	2,720		-	27,000
6. II, PT, W, +	7,500	1,500	3,000	3,000	600		+	40,000
7. II, PT, W, -			3,400	3,400	680		-	40,000
8. IO, PT, W, +	7,500	1,500	5,200	5,200	2,080		+	22,500
9. IO, PT, W, -			5,600	5,600	2,240		-	45,000
10. IO, C, W, +	12,400	6,400					+	15,000
11. IS, C, W, +	19,000	7,720			0	11,000	+	11,000
12. I, Cy, W, -	1,200	200			0		-	10,000
13. I, C, P, +	3,000	1,200			0		+	40,000
14. I, PT, P, -			2,400	2,400	480		-	40,000
15. I, PT, S, -			3,000	3,000	600		-	20,000
16. O, PT, S, -			4,200	4,200	1,680		-	55,000

Table 16. Subsidies received by the average individuals of the groups.
Definition of codes:
1st letters: place of residence: S – suburbs, O – outer city, II, IO, IS – inner city residents who work in the inner city, in the outer city and in the suburbs, repectively,
2nd letters: way of commuting: C – car use, PT – public transportation, Cy – cycling
3rd letter: occupation: W – worker, P – pensioner, S – student
+/-: have a car / do not have a car

	General subsidies, car use: 0.101 EUR/pkm public transportation use: 0.034 EUR/pkm	Air pollution related subsidies car use: 0.214 EUR/pkm Public transportation use: 0.059 EUR/pkm	Public transportation subsidies 0.07 EUR/pkm Monthly pass: 401 EUR/year for adults, 132 EUR/year for students, free for people over 65	Commuting subsidies Car use: 0.028 EUR/km public transportation: 0.048 EUR/km	Parking subsidies 1652 EUR/ year	Total
1. S, C, W, +	1,939	1,224	0	370	0	**3,533**
2. S, PT, W, +	1,096	80	0	528	0	**1,691**
3. O, C, W, +	1,353	1,584	0	0	0	**2,937**
4. O, PT, W, +	1,099	708	214	0	0	**2,021**
5. O, PT, W, -	231	160	337	0	0	**729**
6. II, PT, W, +	860	356	0	0	1,652	**2,814**
7. II, PT, W, -	116	40	0	0	0	**143**
8. IO, PT, W, +	934	444	173	0	1,652	**3,203**
9. IO, PT, W, -	190	132	214	0	0	**536**

10. IO, C, W, +	1,252	1,370	0	0	1,652	**4,274**
11. IS, C, W, +	1,919	1,652	0	308	1,652	**5,531**
12. I, Cy, W, -	121	43	0	0	0	**164**
13. I, C, P, +	303	257	0	0	1,652	**2,212**
14. I, PT, P, -	82	28	247	0	0	**357**
15. I, PT, S, -	102	35	177	0	0	**314**
16. O, PT, S, -	143	99	301	0	0	**543**



21. Figure. Subsidies received by the average individuals of different groups.

Certainly, the mobility patterns of the average individuals of groups are based on rough estimations that could be improved by applying finer and more detailed models. In additions, the amounts of subsidies can vary within groups to a great extent, as e.g. the external costs of air pollution depends on the environmental standard of the car, parking subsidies depend on the exact location of the parking place, distance-based subsidies depend on the distances actually covered.

Nevertheless, it is obvious at first glance of Figure 21. that the distribution of mobility subsidies is highly unequal. Car users typically receive subsidies of some thousands of EUR/year, public transportations users receive subsidies of 300-700 EUR/year, inner city residents who work in the inner city and cyclist receive 100-200 EUR/year. Such an unequal distribution could be considered as just only if it is based on need that is if all persons who receive large amount of subsidies have greater needs than those who receive less subsidies.

As the estimations suggest the most important factors that influence the amount of subsidies one receive is whether he or she commute by car or in the case of inner city residents whether she or he has a car, as car use that entails lot of generic and air pollution subsidies and inner city car ownership usually entails large amount of parking subsidies. Nevertheless, it is rather unlikely that car-owners have greater needs than non-car-owners, as car-owners are more likely to have high income than non-car-owners, as it was demonstrated e.g. by Lucas & Jones (2009). The analysis of the first questionnaire confirm these positive relationships between car ownership and income, as well as car use and income. Figure 22. presents the distribution of respondents based on the per capita net income of their households in the case of non-car-owner and car-owner inner city residents, and Figure 23. presents the distribution of respondents based on the per capita net income of their households in the case of non-car-user and car user commuters. In both cases, car users more likely belong to higher income groups than non-car-users and so they are likely to have smaller needs. Certainly, there are car users with low income who might need subsidies, but the majority of car users have moderate or high income, and there are many non-car-owners with low income who are likely to have higher needs than car-owner or car user people with high income.

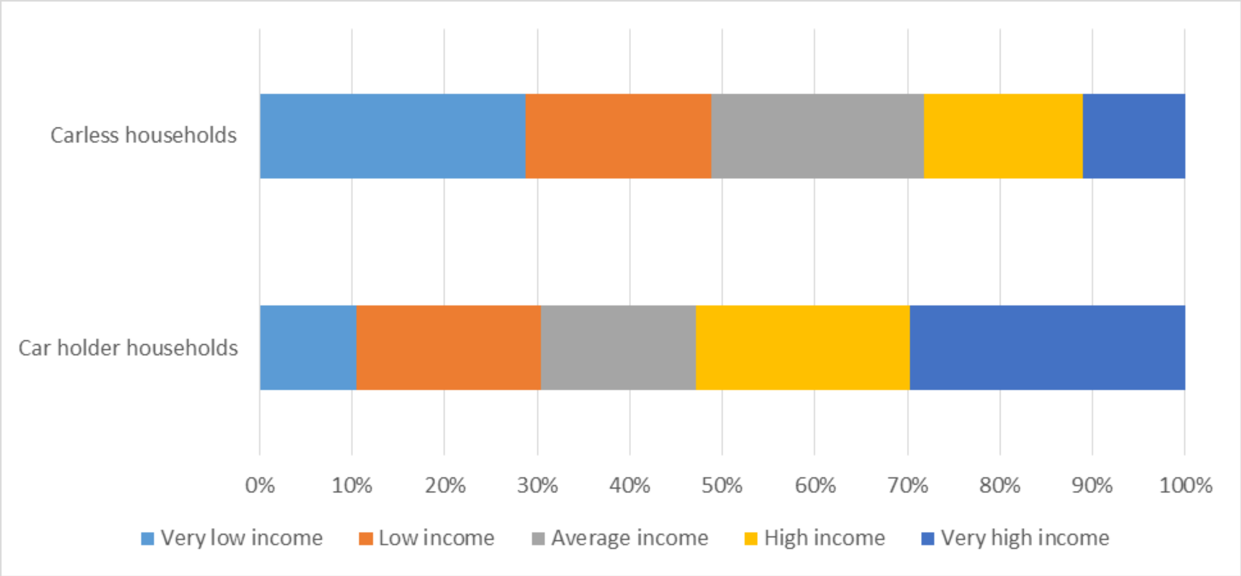


Figure 22. The distribution of respondents based on the per capita net income of their households in the case of carless and car holder inner city residents (N=721). Income categories were determined by the self-categorization of respondents who could choose from the following categories:
below 191 EUR/month (very low income)
between 191 and 318 EUR/month (low income)
between 318 and 478 EUR/month (average income)
between 478 and 796 EUR/month (high income)
above 796 EUR/month (very high income)

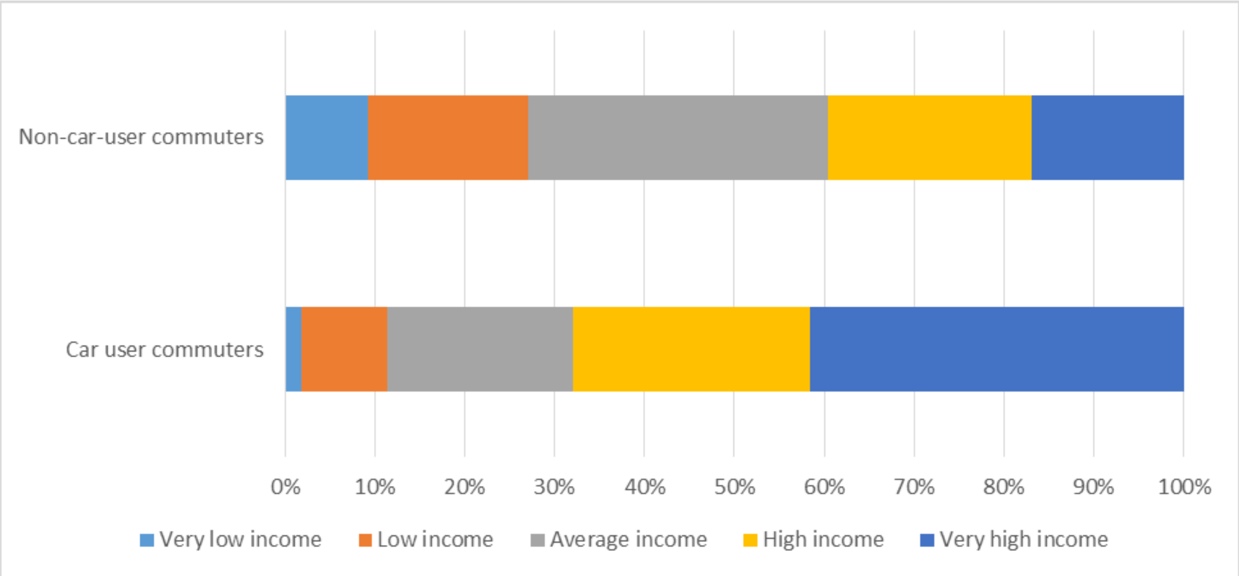
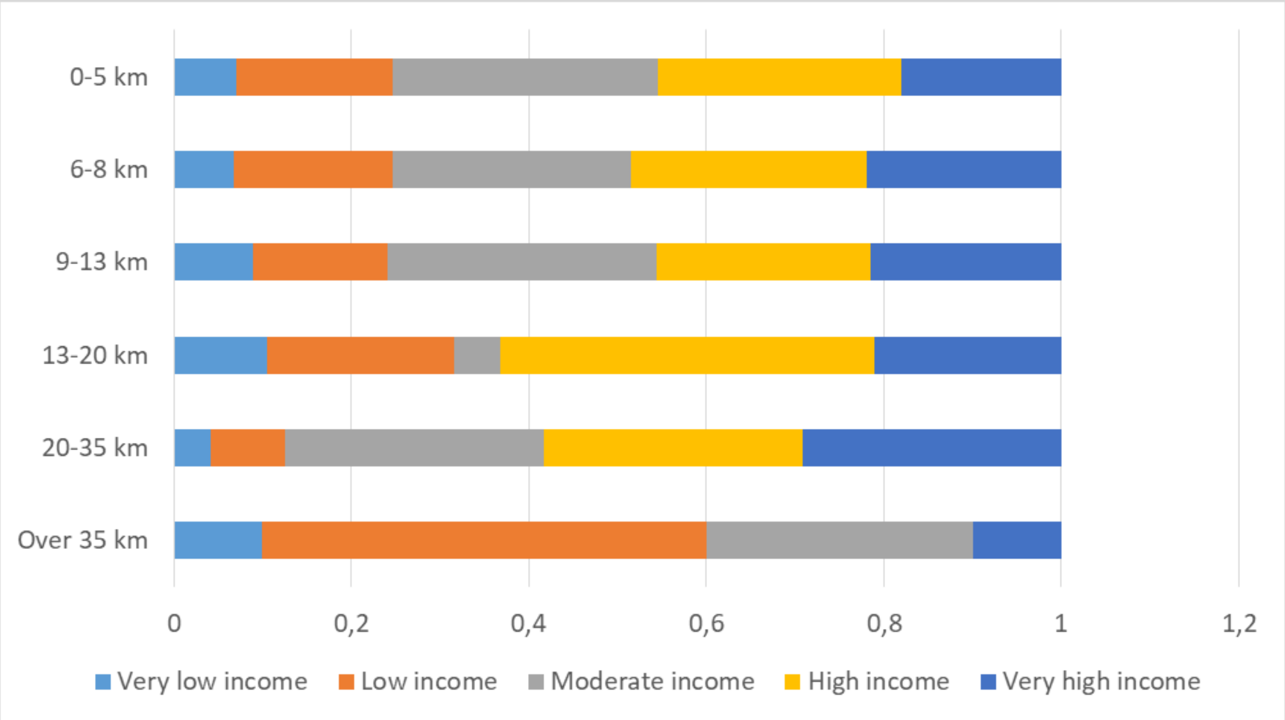


Figure 23. The distribution of respondents based on the per capita net income of their households in the case of commuters non-car-user and car user commuters (N=260). Income categories were determined in the same way as in the case of Fig 18.

Another factor that is likely to influence the extent of subsidies is the distance between the place of residence and workplace, as the higher this distance is, the higher the mobility needs of the commuter is, and higher mobility needs entail higher mobility subsidies in most cases. Fig. presents the distribution of respondents based on the per capita net income of their households in the case of people who commute to the inner city from different distances (distances over 13 km signify commutes from the suburbs). These data suggest that commuters have largely similar incomes regardless from the distance between their places of residence and workplaces. More precisely, commuters from the suburbs in the proximity pf Budapest might have slightly higher incomes, while commuters from further suburbs might have lower incomes, though the number of commuters over 35 km was rather low (10) and so their income distribution might be not representative. Therefore, it is unlikely that people who commute further to their workplaces have generally higher needs than others.



24. Figure. The distribution of respondents based on the per capita net income of their households in the case of commuters who commute to the inner city from different distances. Income categories were determined in the same way as in the case of Fig 18.

Certainly, part of those who commute from outside Budapest to the inner city by public transportation and so receive medium amount of subsidies might have greater needs than people who live in the inner city or people who live and work in the suburbs, but their number is likely to be relatively low, as it suggested by Figure … This is not surprising. First, as it was suggested by Table 2., people are likely to reside primarily in the suburbs of Budapest, because they want to live in a house rather than in a flat and they either cannot afford or do not want a house in Budapest. As the price of a flat in Budapest's outskirts does not exceed substantially the price of a house in the suburbs, the overwhelming majority of those who reside in the suburbs could afford living in Budapest. Therefore, the mobility-related subsidies they receive facilitate them to pursue a lifestyle they voluntarily chose rather than reduce their inevitable needs. Secondly, the overwhelming majority of those who reside in the suburbs and work in the inner city are likely to receive substantially higher salaries than those who reside and work in the suburbs. Therefore, the latter are likely to have higher needs, still they receive much less subsidies. Certainly, there are people who reside in low-quality houses or in low-cost flats in the suburbs and work for rather low salaries in the inner city, but their number is presumably rather low based on these findings.

One might argue that factors other than income might influence the level of need, too. For instance, people who have children might need a car more than others, as it is usually easier to transport children with car than with public transportation or with bicycles. That is if a car user person with children receive more subsidies than others, it could be considered as just. However, it must be noted that when a person use the car jointly with his or her children, then the per capita subsidy he or she receives is likely to be much smaller than the per capita subsidy a single car user receive, and so it is unlikely that persons with children receive more subsidies than others. Another potential factor that influence need is the level of disability of mobility users. Nevertheless, as the number of people with disability is rather low, their potentially larger subsidies are unlikely to have significant impact on the above findings (that is it is unlikely that car users were shown to receive higher subsidies because lot of car users have disabilities).

To sum it up, the findings suggest that the mobility-related subsidies are distributed highly unequally among those who live in the inner city of Budapest or visit it frequently. The difference between the lowest and highest amount of subsidy average individuals of large groups receive is around 5,400 EUR that is around the 60% of the average income of active persons in Budapest (see Table 2.). As many people with low income are likely to receive less subsidies than car-owners and car users with high income, the distribution is unlikely to be based on need and so it can be considered unjust.

6.2. Potential mobility-related subsidy redistribution designs

This section aims to explore potential redistribution designs of subsidies that are based on principles of justice. As desert was excluded as a principle of just distribution of mobility-related subsidies, just redistribution can be based on need or equality.

I argue that those subsidies which contribute to reduced quality of life in the inner city (i.e. generic subsidies, air pollution subsidies and parking subsidies) should be distributed among all the affected people, as a compensation for the reduction in their quality of life. As the personal quantification of quality of life reduction is cumbersome, the distribution should be based on equality. On the other hand, those subsidies that aims (at least in theory) to support those in needs (that is public transportation and commuting subsidies) should be distributed primarily on the basis of need. The following sections propose potential redistribution designs in the case of different subsidy types along these arguments.

6.2.1. Generic external cost related subsidies

As part of these subsidies relates to the external costs of the fuel, energy, material resource consumption of motorized transport, the most straightforward redistribution would entail by taxing these resources and redistributing the revenues in monetary form equally among the population of the jurisdiction which collects the revenues, in this case among the population of Hungary[60]. Actually, the revenue recycling of environmental taxes that already takes place in many countries (Beiser-McGrath & Bernauer 2019, McKenzie 2016) could be considered as an example of such redistributions, but as such policies redistribute the revenues through reducing labour-related taxes, the redistribution might benefit the higher income groups and exclude people who do not work, e.g. children, students, pensioners, etc. Though these issues might be addressed by special taxing rules, the equal distribution of revenues in monetary form seems to be a simpler solution. Such a scheme was proposed by the Agora Energiewende and the Agora Verkehrswende (2019) in Germany (see more details in the literature review), but it has not been realized yet. Another possibility is to redistribute the revenues among those who borne the generic external costs of car use, e.g. among people who live in areas of Hungary particularly affected by climate change, e.g. in the plains in the middle of the country where desertification endangers the livelihood. However, as such redistribution could generate lot of unyielding discussion about who is affected by climate change and to which extent, the equal distribution seems to be more expedient.

Certainly, it can be argued that these revenues, or at least part of it, should be spent on public efforts that can prevent such pollutions. However, as it was mentioned in the introduction, this study explore the environmental problems from a distributive justice perspective that entail the just redistribution of all revenues. In addition, it might be the case that the redistribution of revenues allow higher environmental taxes that are likely to result in more pollution reduction than if part of the revenue from lower environmental taxes were spent on mitigation projects. In addition, the higher environmental taxes are likely to generate pollution reducing developments (e.g. in technology) on their own on a market basis.

6.2.2. Air pollution related subsidies

The redistribution of air pollution related subsidies would entail the collection of fees based on the air pollution of vehicles and the redistribution of revenues. As it is difficult to measure the air pollution of cars, collecting fees that are based on the actual air pollution fees would be complicated, if not impossible. However, since the emissions of vehicles are likely to correlate with

[60] Certainly, as generic external costs affect all people in Earth, they should be distributed globally. However, as such

the distance travelled, the collection of air pollution fees could be based on vkm made in urban areas. As the external costs of air pollution are higher in the densely populated inner parts compared to the outer parts of cities, and as the external costs of air pollution are likely to be influenced by the environmental classification of the vehicle, the air pollution fee per km should be higher in the inner cities and should depend on the classification of the vehicle. The revenues should be distributed among the population of the city either equally or according to the level of mobility-related air pollution. In the latter case, the residents of areas where road transport contribute to air pollution to a higher extent could receive higher subsidies. Nevertheless, as it is rather complicated to measure the contribution of road transport to air pollution, an equal redistribution among the all resident of Budapest seems to more realizable. Assuming that the internalization of all air polluted external cost would reduce the external costs of mobility-related air pollution by 50% (through reducing road traffic and by shifting to less polluting vehicles), the revenues stemming from payments for the the remaining air pollution would be 572.5 million EUR/year that would entail a subsidy of 331 EUR/year/capita in Budapest.

6.2.3. Parking subsidies

The redistribution of residential parking subsidies would entail higher residential parking fees and the redistribution of revenues. As the value of public space is higher in the centre, the closer the location to the centre is, the higher the parking fees should be. In cases when the on-street parking spaces are not designated for each car – that is common in the inner city of Budapest - public space consumption of parking exclusively depends on the size of the car, anf so parking fees could depend on the size of the car, too[61]. Currently, parking fees in some cases (Decree of Budapest capital 30/2010) depends on the environmental classification of the car. Though this might encourage

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redistribution would entail massive money transfers between countries (Carratini et al. 2019), it is unlikely to be realized any time soon.

[61]When parking places are designated individually, then the parking space consumption is regardless from the size of the car, as even the paking of a small sized car would require a whole parking space.

people to use less polluting cars, in the long term it is likely to result in the overuse of public space by those cars. In addition, as cars with better environmental classification are typically more expensive than cars with worse environmental classification, providing such a discount is likely to be a perverse subsidy provided to the well-to-do. Revenues should be distributed equally.

It must be noted that the reduction of parking subsidies would entail revenues not only from higher residential parking fees but e. g. from fees paid for terraces that occupy a part of the freed parking space.

6.2.4. Public transportation subsidies

Currently, one of the primary aims of public transportation subsidies is to prompt people to use public transportation instead of cars. Therefore, the redistribution of public transportation subsidies should take place only after car use-related subsidies were reduced or redistributed. Otherwise, public transportation subsidy redistributions could make public transportation users to shift to car use, as the price of car use would become more competitive. In addition, as public transportation subsidies are much smaller than car use subsidies, their redistributions are less important. Nevertheless, as the distribution of public transportation is currently unjust in its own, the focus on distributive justice of mobility-related subsidies requires the exploration of the potential redistribution of public transportation subsidies, too.

Public transportation use in Budapest is subsidized rather particularly, as intensive use with passes is subsidized to a rather great extent, moderate use with passes is subsidized to a mall extent, low-key use with passes is not subsidized, and in the case of occasional use by ticket public transportation users pay more than the full costs per pkm of the public transportation. In addition, students and pensioners under 65 receive extra subsidies, but only if they use public transportation by passes and people over 65 receive 100% subsidy as they travel for free. If the operation costs of different routes are differentiated, then it can be argued that the users of peripheral routes receive even more subsidies as the ridership in those routes are typically much lower than in the inner city or in high-capacity routes between the inner city and the outer city centres (Börjesson 2020). That is trips on inner city public transportation routes, where ridership is high, are likely to receive less subsidies than trips on many peripheral public transportation routes, where ridership is low. Taking these differences into account, it might be suggested that prices could be lower in routes with high ridership than in routes with low ridership (see details below).

The more equal redistribution of public subsidies would require transforming of the current ticket system that is based on subsidized monthly passes, as the existence of monthly passes contributes to the unequal distribution to a great extent. Monthly passes should cease, and km (or minute) based pricing should be introduced. There are different options for km based pricing. In the case of uniform pricing the price of one km travel would be the same regardless of the route and the time of the travel. However, such a pricing would be still unjust to some extent as the actual costs of public transportation use depends on the route and time of the travel[62]. If the actual costs of a route are considered, then the km price would be likely lower in the inner city and in the busy routes between the inner city and the populous subcentres in the outskirts of Budapest and it would be higher in the suburban routes and on the peripheral routes that enmesh the low-density parts of the outer city. Such higher peripheral prices could have several effects. First, more people would reside in Budapest instead of the suburbs, and within Budapest more people would reside closer to the inner city or to high-capacity routes. Secondly, more people would use bikes between their home in low-density areas and the closest station of high-capacity routes. Thirdly, the higher prices would allow the implementation of a demand-driven public transportation service with minibuses.

As the extraordinary demand at peak hours increases the overall costs of public transportation due to the excess demand of vehicles and personnel, the costs of peak hour trips can be considered higher than the costs of trips made outside the peak hours. If these higher costs were

[62] Certainly, the actual cost of public transportation use might depend on the mode of the transport, too, but if this is reflected by the prices, too, then people might be discouraged to use the metro lines then would be disadvantageous.

manifested in prices, then the excess demand would be lower and so the overall demand for public transportation could be served more efficiently.

In summary, if the pricing of public transportation was based on km-prices which reflected better the differences in costs of trips made in different routes at different times, then public transportation could be based on a network of high-capacity routes being operated probably at a lower cost level than today (due to the more even demand) and on a demand-driven service at the periphery being operated at a higher cost level. And if these km-prices (and car use) were less subsidized than today, then more people aspired to reside within or closer to the inner city or closer to their workplaces, or to work closer to their place of residence, and higher proportion of trips were made by bicycle or scooter (by electric ones if the terrain is not flat or the distances are large) or on foot.

Nevertheless, it is rather uncertain whether the public transportation subsidies can be reduced to a great extent, since the infrastructural and operational costs of public transportation is not directly proportional to the volume of public transportation traffic. And such volume is highly unpredictable, as while higher prices of car use are likely to increase the demand for public transportation, the higher prices of public transportation would decrease it (by lowering mobility needs and by encouraging cycling and walking). Therefore it is highly uncertain whether the ticket revenues would increase and to which extent. On the other hand, the infrastructural and operational costs would decrease probably to a smaller extent than the volume of traffic. Therefore it is possible that public transportation would require similar subsidies than today, at least in the short term. Nevertheless, in long term, when public transportation is primarily would rely on busy high-capacity routes and on demand-driven services, the subsidy requirements of public transportation would be likely to be smaller than today.

As public transportation subsidies partly target people with low income – e.g. students, pensioners, people over 65, and unemployed people - the redistribution of freed subsidies in monetary form should be based on needs. That is the subsidies should be distributed among the above groups and another low-income people. And in order to make changes less radical, daily, weekly and monthly caps could be introduced in the initial period to provide people enough time to accustom to the new prices. In addition, extra funds could be provided for those who have low income and are under the necessity to take long trips for some extraordinary reasons.

I acknowledge that the overwhelmingly dominant public and expert perception is currently that public transportation should be subsidized. One of the main rationale behind this perception is that subsidized public transportation is necessary to seduce car users with prices lower than car use. However, this rationale is no longer valid when car use is not subsidized either, since then the difference between the price of car use and public transportation use would be larger than today. The other main rationale according to which public transportation subsidies are necessary is to support the poor. However this rational is false, since the poor can be subsidized otherwise. Still, due to the supporting views about public transportation subsidies, it can be argued that public transportation should be still subsidized to some extent and so the km fees or the caps could be lower than suggested above. However, the existence of student public transportation subsidies is likely to be hardly justified, as many students would be likely to be willing to use the bicycle or scooter if they received monetary subsidies instead of subsidies in the form of discounted pass prices, the annual values of which is 230 EUR (i.e. the annual price of student pass is around 230 EUR lower than the price of normal pass). If students received this amount annually, they could spend it not only on public transportation but on cycling, apartments closer to their college or university, etc.

6.2.5. Commuting subsidies

Commuting subsidies differ from the external cost related subsidies, too, as they theoretically target those who cannot find a proper job in their settlements and so are forced to take long and normally costly commutes, and due to their low income they can afford neither the high costs of commuting nor the higher costs of residing closer to job opportunities. That is the distribution of commuting subsidies aspires to be based on need, and as such, it could be considered just. However, particularly in the Budapest metropolitan region, it is rather likely that the majority of those who commute from the suburbs to the often well-paid inner city workplaces have no financial constraints that prevent them affording the commuting costs, and they reside voluntarily in their spacious suburb house instead of a flat in Budapest. In addition, it is rather likely that though there are people for whom the commuting subsidy is an important support, there are also unemployed people or people who work locally in low-paid positions that have higher needs than the majority of commuters. And as the commuting subsidies are tax exemptions and so they are provided from national resources, their redistribution should prioritize those who have the greater needs in Hungary. The majority of these people are likely to live in more remote areas of Hungary than the rather accessible Budapest metropolitan area.

The abolition of public commuting subsidies can take place in two ways. One option is the abolition of the tax-free status of the refunds of commuting costs. In this case workplaces would be still required to subsidize commuting, but they should pay taxes after the subsidy. However, such a requirement still can be considered as an indirect public subsidy, as it is based on public legislation, and in the public sphere it would still signify a direct public subsidy, as it would be financed from public resources. Therefore, in order to cease the commuting subsidy completely, the requirement to refund any commuting cost should be ceased, too. The abolition of commuting subsidies would entail higher tax revenues which could be redistributed among those who live in an area with limited accessibility and have low income. Assuming that the amount of subsidies at the country level is twice as much as in the case of Budapest, that is 338 million EUR, and that the extra tax revenues would be 20% lower than the earlier tax evasion due to the change in travel patterns incited by the higher commuting costs, 270 million EUR could be redistributed. Assuming that 17.5% of 4 million households in Hungary (KSH 2019) have justified needs, the redistribution of 270 million EUR could signify an average annual subsidy of 386 EUR in the case of these households.

7 PUBLIC PERCEPTIONS ABOUT THE JUSTNESS OF SUBSIDY DISTRIBUTION AND POTENTIAL SUBSIDY REFORMS

The previous chapter illustrated the rather unjust distribution of mobility related public subsidies. This unjustness is however likely to continue for several reasons, one of them being the lack of awareness regarding the injustice. Due to the lack of this awareness people usually do not consider a potential redistribution, as they do not see the current one as a problem. And since people do not want to change it, decision-makers do not consider it as a problem either. This chapter aims to explore the public views about current and potential alternative subsidy distributions when the people are informed about the (in)justice aspects of current distributions. The exploration is based on three questionnaire surveys in which people could express their views by answering questions that addressed the injustice of subsidy distributions.

7.1 The first questionnaire survey

In the first questionnaire survey, people were asked to express their views about two unjust aspects of inner city car domination. One of these aspects was the situation that inner city car users are entitled to use more public outdoor space for free in the form of public parking places (car users pay nothing or only administration costs) than carless inner city residents as the latter are not entitled to use those parking places for any non-parking activities. As Figure 25. presents, only 23% of the respondents found it absolutely fine, while 52% of them found it somehow unfair (the others were ignorant or uninterested in the issue). However, the majority of those who found the situation unfair thought that paying for local parking – which would be the obvious way of reducing the unfair situation - would also be unfair. Interestingly enough, the situation was somewhat similar in the case of carless respondents, because though only 12% of them found the situation absolutely fine, and 58% found it unfair, a slight majority of the latter also found paying for local parking unfair. It must be noted that – based on some comments on the questionnaire – some people might thought that paying for local parking means paying the same parking fees as visitors and with parking limited to 3 hours (which would not be the case in any likely scheme to reduce residential parking subsidies).

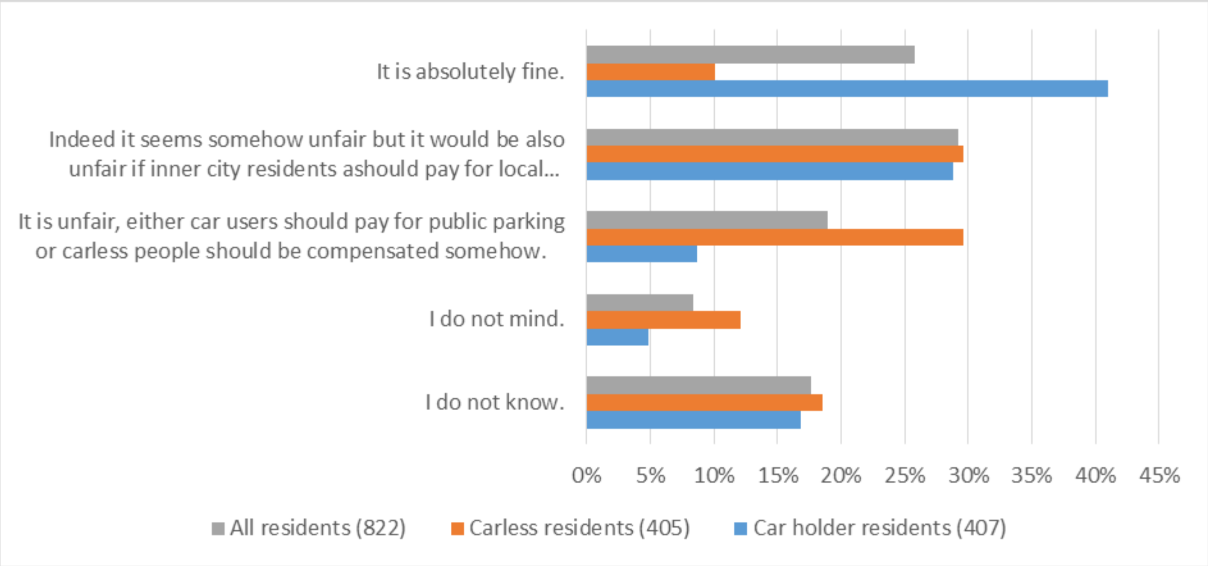

Figure 25. Responses to the "Currently inner city car users are entitled to use more public outdoor space for free in the form of public parking places (car users pay nothing or only administration costs) than carless inner city residents as the latter are not entitled to use those parking places for any non-parking activities. What do you think of this situation?" question in the case of all residents, carless residents and car holder residents.

The other aspect was the claim that car use in the inner city has significant negative effects (e.g .air pollution, congestion, etc.) and the taxes or fees currently paid by car users do not compensate for them. The responses show similar patterns as in the case of the other aspects (Figure 26.) While 27% of all respondents found the claim untrue or true but fine, and 54% of all respondents found it unfair, the majority of those who found it unfair thought that higher taxes or fees of car use would be unfair, too.

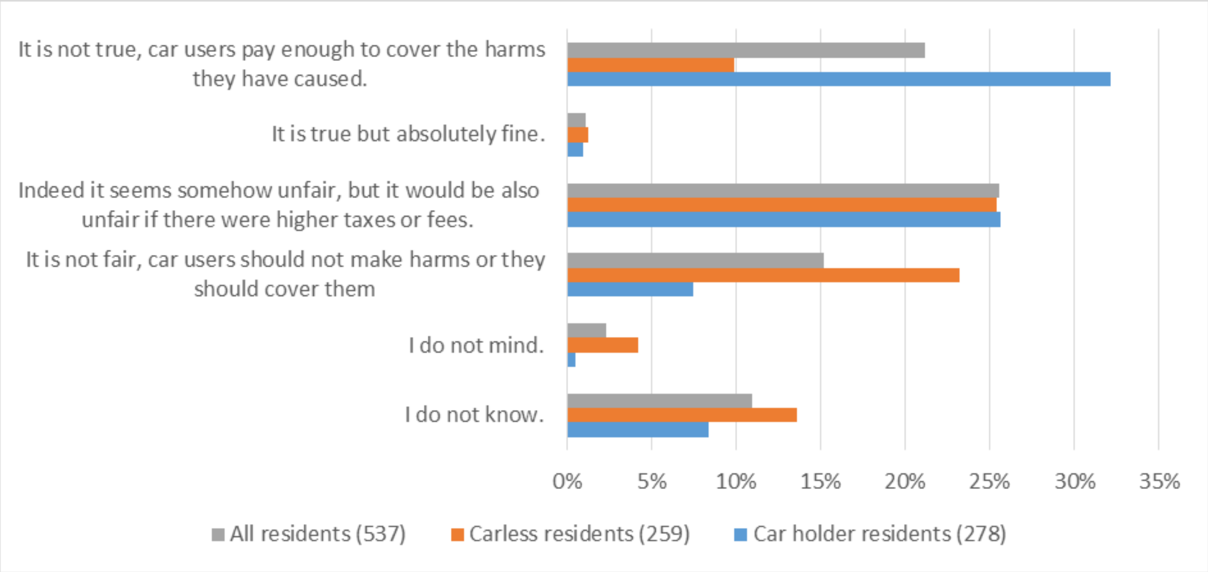

Figure 26. Responses to the "It is often claimed that car use in the inner city has significant negative effects (e.g .air pollution, congestion, etc.) and the taxes or fees currently paid by car users do not compensate them. What do you think of this situation?" questions in the case of all residents, carless residents and car holder residents.

The responses for both questions suggest that the majority of people can easily perceive the unjust nature of car use related public subsidies. However, probably due to the embeddedness of these subsidies in everyday life, many people consider the reduction of these subsidies as unfair, too.

7.2 The second questionnaire survey

The second and third questionnaire surveys focused on concrete public subsidies in the 7th district of Budapest. Based on Assembly Decree 30/2010 the annual parking fee for inner city district residents is 250 times the hourly parking fee that is around 279-418 EUR in much of the inner city. This is already a rather subsidized fee as the use of such a public space normally costs around 1300-6000 EUR/year as it was presented in chapter 5 and the subsidy analysis estimated the annual value of inner city parking place as 1652 EUR. However, all inner city municipalities subsidize by 100% even this discounted parking fee, and so parking is free for the local residents, though some municipalities apply a registration fee of 3-7 EUR/year, which are frequently mistaken as a parking fee by local residents (this registration fee is 7 EUR/year in the 7th district).

The municipality of the 7th district issued parking permits to 7,946 households in 2020. The number of households in the 7th district is rather uncertain, because many flats dwelled by unregistered tenants and many flats were transformed into Airbnb apartments since the last census, when the number of households was 29,544 (KSH 2013). Therefore, I estimate the number of households to be 27,000, and thus the proportion of permit holder households is estimated to be 29%. Nevertheless, the proportion of adults who live in a permit holder household, is likely to be a bit higher as the average number of adults in permit holder household is likely to be higher, according to the questionnaire, these numbers are 2.56 and 2.13, respectively. Based on these numbers, the proportion of adults living in a car holder household is around 33%.

In the second questionnaire, two questions addressed the distribution of parking subsidies. In the first question, respondents were informed how much subsidy is provided to the car holder and carless households and were asked about their opinion of this situation (Figure 27.). The majority of respondents (51%) found the situation as problematic. However, if the responses are weighted according to their estimated proportion in the adult population (33%) permit and the 'I do not mind' and 'I do not care' responses are excluded from the analysis, the 65% of responses found the situation as problematic. As there is no substantial differences among the responses of people with different education level, it can be assumed that the underrepresentation of low-educated people does not influence this result. On the other hand, whether the respondent has a permit or not, influences strongly his or her response, as is indicated by the figure. This means that many people judge the fairness of the situation according to the perceived benefits or disadvantages the situation has for them. Around half of those who thought that the current distribution of parking subsidies is problematic, would prefer an equal distribution of subsidies, while a third of them think that only needy ones should be subsidized (the others thought that the problematic distribution is unchangeable).

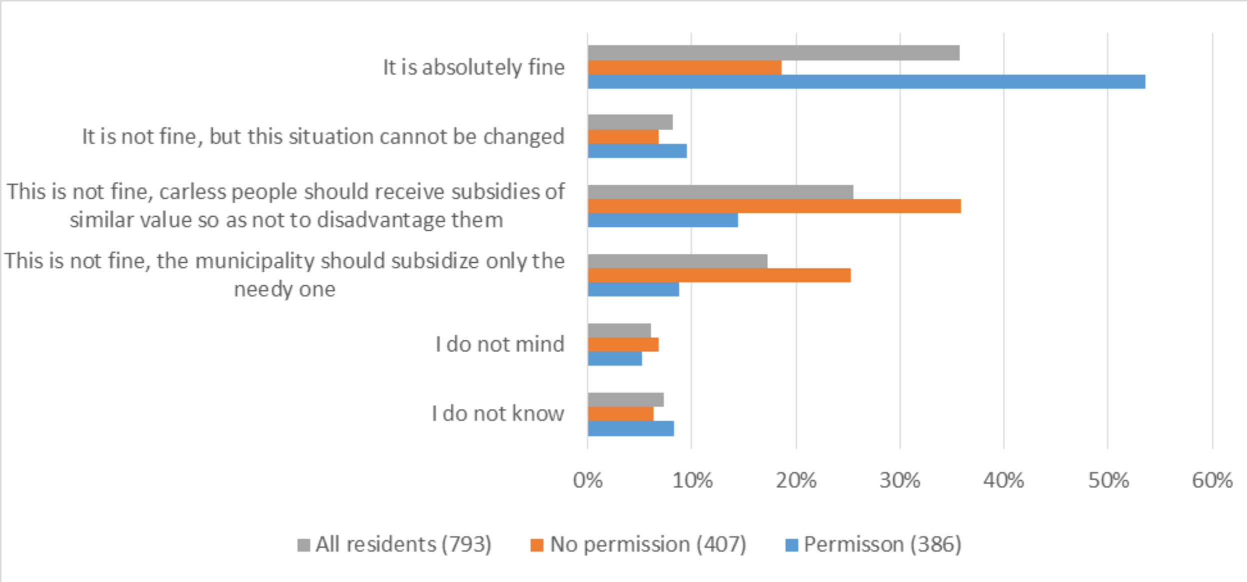

Figure 27. Distribution of responses to the following question: "The parking decree of the municipality of the 7th district provides 279-350 EUR/year subsidy (100% discount from the annual parking fee of 279-350 EUR determined by the parking decree of Budapest) to each car owner, while the carless households do not receive any general subsidy. What do think of this situation?"

In the case of the second question, respondents were asked to express their opinion regarding a potential policy that would provide equal subsidy to each resident of the district that could be used for parking, carsharing, public transportation, cycling, etc. (Figure 28.). The majority of respondents (55%) thought that it is a good idea, though 13% thought that is infeasible. However, if the responses are weighted according to the estimated proportion of adults with permit in the population (33%) and the 'I do not mind' and 'I do not care' responses are excluded from the analysis, 66% of respondents considered the proposal as a good idea (52% of respondents considered it as a very good idea). As 80% of those who stated that only those in need should receive subsidies considered the proposal as a good idea, it can be assumed that equal redistribution of revenues can be accepted even by those who generally prefer that only those in need receive subsidies. This is important because a redistribution based on need is likely to require more resources to check whether the applicants are eligible for the subsidy, and it would reduce the number of those who benefit monetarily from the proposal. And as many people seem to judge policies on whether they benefit from it or not - that is rather than on a moral basis – a policy that entails fewer beneficiaries is likely to be less popular.

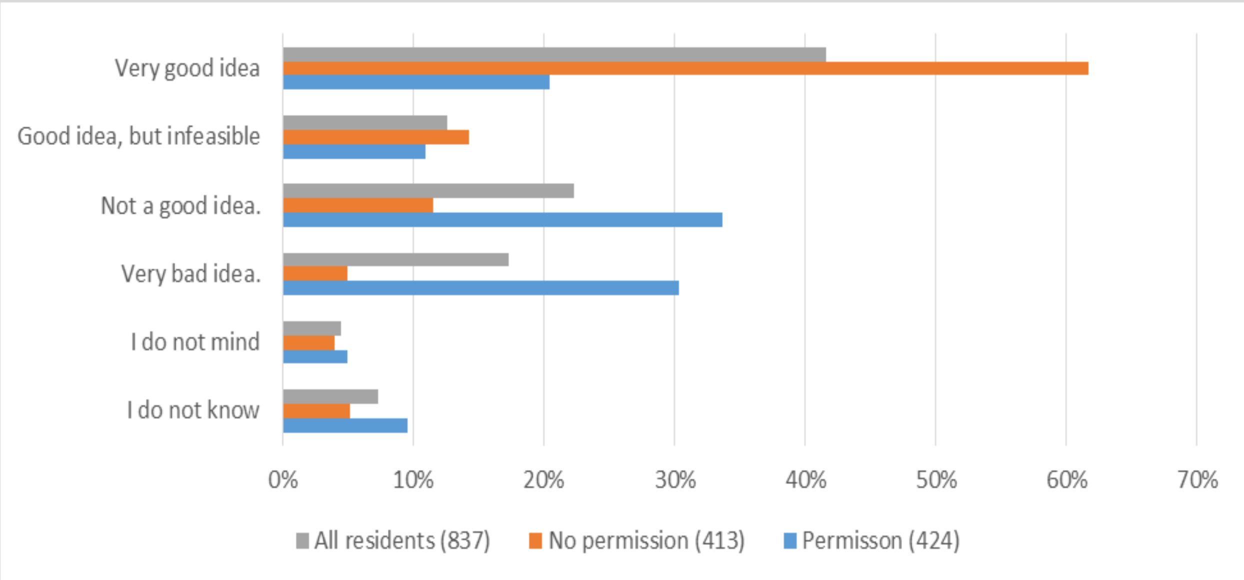

Figure 28. Distribution of responses to the following question: "What would you think of a policy that instead of the current parking subsidy would provide subsidy of 64-80 EUR/year in a form of coupon that could be spent on parking, carsharing, public transportation, cycling, etc.?"

7.3 The third questionnaire surveys

The third questionnaire focused primarily on parking subsidies. At the beginning of the survey, respondents were asked to express their opinion about reducing the parking subsidies of around 350 million EUR/year and spending the freed resources on other important purposes (Figure 29.). The majority of all respondents (57%) disagreed with this proposal, and the proportion of opponents (44%) exceeds the proportion of proponents (42%) even if the permit holders weighted according to their estimated proportion (in this questionnaire, the proportion of permit holders (70%) exceeded their estimated proportion substantially (33%). Interestingly enough, even the 30% of people without permit disagreed with directing public resources from parking subsidies to another purposes. This suggests that subsidies are popular for many people even if they do not benefit from it.

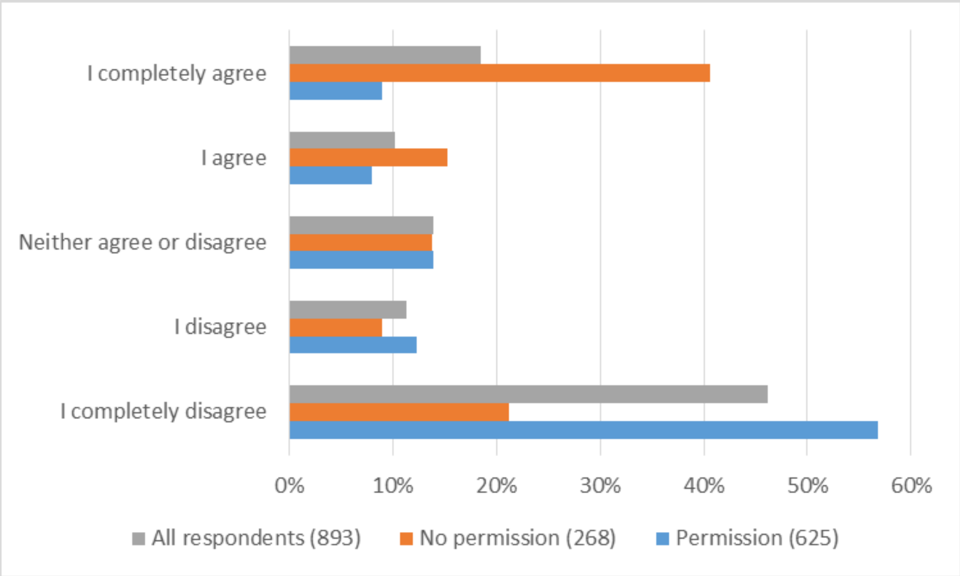

Figure 29. The distribution of response to the following question: “Currently the municipality provides a discount of around 318 EUR/year in the case of each residential car from the parking fee determined legally, in total around 3.5 million EUR. Do you agree that the municipality should reduce this subsidy and should spend the freed resources to other important purposes or subsidies?”

Another question asked people to express their opinion whether the municipality should subsidize the car holder and carless households to a similar extent (Figure 30.). In this case, the proportion of proponents exceeded the proportion of opponents even in the case of permit holders (49% to 33%), if the proportion of permit holders are weighted according to their estimated weight, then proponents constitute a distinct majority (66%). Even the 45% of those who disagreed with reducing the parking subsidies agreed that car holder and carless household should receive similar subsidies.

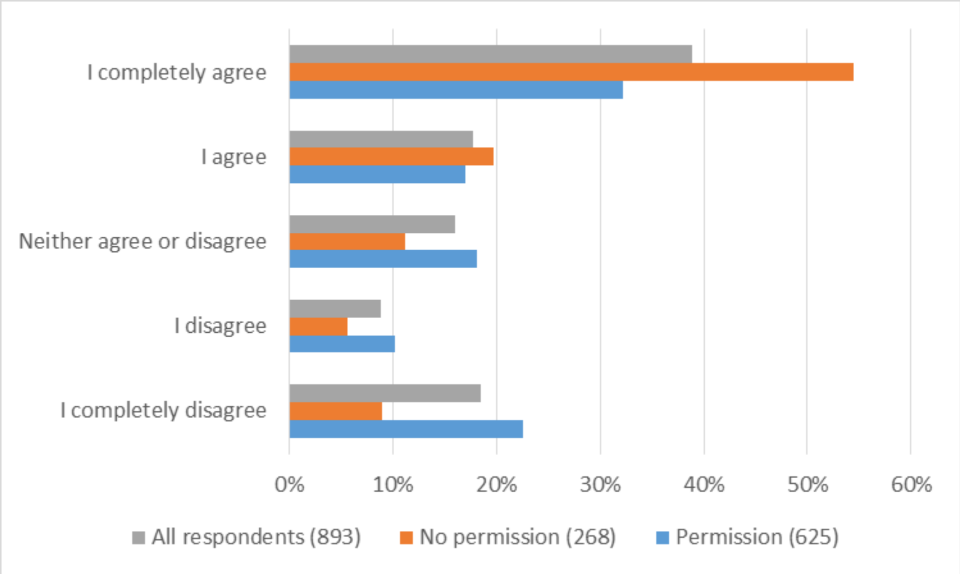

Figure 30. The distribution of responses to the following question: "Do you agree that the municipality should subsidize the car holder and carless households of the 7th district to a similar extent?"

Later, respondents were asked about the extent of subsidies they consider justified in the case of five groups with different income level, respondents could select every 10% from 0% to 100%. To avoid misunderstanding, the answers specified the approximate amount of annual parking fee each extent of subsidy would entail. The results suggest that the higher the income of a group is, the lower the extent of subsidies is the people consider justified in the case of the group (Table 17.). Interestingly enough, in the case of groups with at least average income the majority consider subsidy reduction as justified even in the case of permit holders. And in the case of groups with more than average income, even the majority of those who support certain subsidy reduction disagreed with the subsidy reduction in an earlier question. Why did they change their opinion? I argue that there are the following explanations. First, the earlier question did not specify the extent of reduction and so many respondents might have believed that reduction means 100% reduction that they might have considered too high. Secondly, the categories based on income level might make some respondents realize that rich people receive parking subsidies, too, which some respondents found unjustified. Thirdly, there were some questions between the earlier and latter questions that raised the possibility to subsidize other groups, e.g. the public transportation use of children, or to spend the public resources on other purposes, e.g. on developing green areas and so some people might find these possibilities more important than subsidizing parking.

Table 17. Proportion of respondents who considered a certain extent of parking subsidy as justified in the case of people with different income.

	Extent of subsidy considered as justified	People with much lower income than the average	People with lower income than the average	People with average income	People with higher income than the average	People with outstanding income
All respondents	*0%*	9%	9%	10%	21%	40%
	10%	2%	3%	4%	4%	3%
	20%	2%	3%	3%	6%	3%
	30%	1%	2%	3%	5%	3%
	40%	1%	2%	3%	3%	1%
	50%	10%	10%	16%	13%	10%
	60%	1%	4%	3%	2%	1%
	70%	4%	6%	6%	4%	3%
	80%	7%	8%	7%	6%	4%
	90%	9%	11%	9%	7%	5%
	100%	**54%**	**43%**	**36%**	**29%**	**27%**
Respondents who do not have permit	*100%*	**34%**	**24%**	**17%**	**14%**	**13%**
Respondents who have permit	*100%*	**63%**	**51%**	**44%**	**35%**	**33%**
Respondents who had disagreed with reducing parking subsidies	*100%*	**70%**	**61%**	**54%**	**44%**	**41%**

Based on the above findings the following conclusion can be suggested. Not surprisingly, subsidies are popular – maybe unless they are given to disliked people – and so subsidy reductions are unpopular, even among those who do not receive subsidies. It seems that many people perceive municipal or state budgets as unlimited or do not perceive a relation between the amount of subsidies and the amount of public resources available for other purposes. For example, in the textual responses of the second questionnaire many people commented that they would agree with subsidizing all residents equally, were the individual subsidies much higher. In addition, many people seems to question that more public resources entails more spending on public purposes; they rather believe that more public resources lead to higher corruption or higher salaries of lazy municipality officials.

Nevertheless, it seems that simply raising the possibility of spending more on popular purposes, proposing only partial reduction of subsidies, or confronting people with the fact that high income people receive subsidies, too, make people, particularly those who do not receive subsidies, consider that subsidies should be reduced, particularly in the case of those who do not need it. As most people do not receive parking subsidies, the above actions can lead to a solid majority who accept or even request partial parking subsidy reductions.

Finally, it seems that if equal subsidy redistribution (that is providing general subsidies instead of parking subsidies) is offered instead of subsidy reduction, then the majority can accept the redistribution of even the whole subsidies. This is important because the higher the parking subsidy reduction is, the higher its effect on demand for public parking. Thus, subsidy redistributions can lead to lower parking needs, and so more public space freed up to other purposes than simply subsidy reductions.

The demographic characteristics seem to play a minimal role in how people perceive the issues of injustice. More precisely, the level of education might have a role as people without high school graduation seem to be less willing or able to think of these issues, as indicated by their responses. Namely, while in the first questionnaire 25% and 15% of graduated people selected the ‘I do not mind’ or ‘I do not know’ responses for the two justice-related questions, 38% and 51% of people without high school graduation did so. On the other hand, in the justice-related question of the second questionnaire this difference was less accentuated, as while 13% of graduated people selected these answers, 21% of people without high-school graduation did so. Nevertheless, it must be mentioned that the number of respondents without high school graduation was rather low in the case of these questions, 74, 41, 78, respectively, and so this difference might be note representative to the population without high-school graduation of the inner city or the 7th district.

8 DISCUSSION

This chapter first discuss the findings of the research in relation to the research questions and hypotheses and then contemplate on the potential barriers of subsidy reforms.

1. What subsidies exist in the transport domain of Budapest metropolitan area? How do such subsidies influence inner city car domination?

The research identified and estimated five different subsidy types in the transport domain of Budapest: subsidies related to generic external costs, subsidies related to the external costs of air pollution, parking subsidies, public transportation subsidies and commuting subsidies, which altogether amount to 1,569 and 665 million EUR/year in the case of car use and public transportation, respectively, and to 2,234 million EUR/year in total that is around the 6% of Budapest's GDP (KSH 2017). The two external cost related subsidies are the main element of subsidies, as they constitute 81% of all subsidies. These subsidies reduce the individual monetary costs of motorized transport by 33-100%.

Based on the study of Városkutatás Ltd. (2009) it can be assumed that the mobility-related subsidies increase car use at least by 113%.

2. How are inner city related mobility subsidies distributed among the inner city residents and the frequent visitors of the inner city? How just is this subsidy distribution considering the principles of what constitutes a just distribution?

These research question aimed to test the 1st hypothesis that is 'the distribution of mobility-related subsidies is unjust'. The findings of the subsidy analyses suggest that thy hypothesis is correct, that is if all mobility-related public costs are considered as public subsidies, then the distribution of such subsidies among the residents and frequent visitors of the inner city of Budapest is highly unjust, as it is highly unequal, and is not based on need. The inequality of mobility-related subsidies was demonstrated by identifying groups of large number of people with assumingly similar mobility patterns and by estimating the amount of subsidies the average individual of each group receives. The findings suggest that the per capita amounts of subsidies these groups receive are likely to range from around 100-200 EUR/year to 5,500 EUR/year, and so the largest difference is around the 60% of the average income of an active Budapest resident. The primary factors that influence the amount of subsidy a person receive are whether the person own and use a car, and the distance between his or her place of residence and workplace. The findings confirm that car ownership and car use is inversely related to income (as it was demonstrated in other studies), and also suggest that the distance between the place of residences and workplaces is largely unrelated to income. Certainly, in some cases mobility-related subsidies might be justified by need, for instance, in the case of low income people who cannot afford even a cheap flat in Budapest and so are forced to live in low-cost suburban or countryside housing and can find a job only in the inner city, but the number of such people is rather low based on the first questionnaire. As low income is considered as the key determinant of need in this research, these findings suggest that the highly unequal distribution of mobility-related subsidies is unlikely to be explained by need and so it is highly unjust.

3. What would be the designs of just redistributions of subsidies?

The unjust distributions of mobility-related subsidies raise the possibility of more just redistribution. Such redistribution in the purest form would entail on the one hand urban road fees, usage based and higher public transportation prices, higher residential parking fees, and the cessation of tax-free commuting subsidies and tax-free use of company car for private purposes, i.e. measures to make users pay for their use of public infrastructure and environmental resources, while on the other hand freely consumable monetary subsidies distributed either equally or based on need, the source of which would be the revenues from the higher fees, prices and more taxes. Whether the distribution of freely consumable monetary subsidies is based on equality or need, can depend on the rationale behind current subsidies, on balance between the revenues and number of people in need, on the costs of eligibility tests for subsidies based on need, or on the social values. I argued that as most mobility-related subsidies do not target the poor, the potential revenues are large, the number of people in need is not particularly high in the Budapest metropolitan area compared to other regions, a distribution based on equality (at least partially) seems more expedient than a distribution based purely on need. Distribution based at least partially on equality means that everybody would receive monetary subsidies, but the poor would receive more. Nevertheless, as the rationale behind commuting subsidies and public transportation subsidies in the case of students, pensioners and people over 65 is their typically low income – i.e. their need - in their case it is expedient to distribute the revenues on the basis of need.

Certainly, regarding inner city car domination, the redistribution of car use related subsidies is much more important than the redistribution of public transportation related subsidies. It can be even argued that as the redistribution of all car use related subsidies would alone reduce inner city car traffic and car parking several times, the redistribution of public transportation related subsidies, the impact of which on inner city car domination would be likely to be minimal compared to the impact of redistributing car use related subsidies, is not necessary, particularly as public transportation subsidies are widely accepted and considered as environmental-friendly form of subsidies worldwide. However, I still argue for redistribution of public transportation related subsidies for two reasons. First, public transportation subsidies are unjust in their own, and so the endeavour for social justice entails their redistributions. Secondly, public transportation subsidies, particularly in suburban mobility, are likely to amplify urban sprawl as they make large-distance commuting cheaper, easier and quicker (Redding 2021). And as in suburban areas, public transportation and cycling cannot compete with car use beyond the routes between the suburbs and the city centre due to the low travel density and long distances, public transportation subsidies are likely to entail more car use outside the inner city and so higher ecological footprint due to urban sprawl (Jones & Kammen 2014). As it can be argued that on the verge of climate emergency societies should aspire to reduce their ecological footprint reduction as possible, public transportation subsidies should be redistributed. Certainly, only in that case if car use related subsidies are reduced or redistributed, as otherwise part of public transportation users might shift to car use.

The issue of public transportation subsidy redistribution is well illustrated by the progressive thoughts, opinion leaders - for example the chief architect of Budapest, the CEO of Budapest Development Centre - expressed about the necessity of reducing car use in Budapest in recent years (Zubreczky and Zsuppan 2020, hvg.hu 2019). I argue that based on these thoughts, two distinct visions can be formulated about a less car-dominated urban Budapest. One of them is the vision of the 'compact city', the guiding principle of which is to reduce mobility needs by creating a more compact metropolitan area where more people live in Budapest and particularly in the inner city or its proximity, and where more people work, study and pursue other activities in the proximity of their place of residence as it is suggested by the principles of the 15-minute city (Moreno et al. 2021). Such a vision would probably require several measures, including the rehabilitation of brown zones within or in the proximity of the inner city, the reduction or redistribution of all mobility subsidies. It would contribute to less car-dominance throughout the metropolitan area through reducing mobility needs in general and by facilitating bike use and walking. The other vision might be named 'rail city' and its guiding principle is to replace car use by public transportation by creating a rail network that connects the suburban centres with the inner city and enmeshes much of Budapest, and it would contribute to less car dominance in Budapest through encouraging people to shift from more expensive and limited car use to cheap, quick and comfortable public transportation (or to cycling in some cases). Though this vision would require the reduction or redistribution of car use related subsidies, too, it would subsidize public transportation even more, as the improvement of the rail network in the Budapest metropolitan area would require enormous public subsidies: the backbone of the rail city vision is the Budapest Agglomeration Railway Strategy 2040 that plans to spend around 6 billion EUR on railway developments in the metropolitan area of Budapest till 2040 (BFK 2021). These enormous public monetary resources are likely to grow the inequality of the distribution of public transportation related subsidies, as they benefit the relatively few suburban commuters to a much greater etent than the much more numerous Budapest residents. In addition, as these developments are likely to encourage further urban sprawl (Brueckner 2003), they are likely to increase the ecological footrprint of Budapest metropolitan area, as the eological footprint of suburban lifestyle is higher than that of urban lifestyle (Kovacs et al. 2020). Finally, the intvestments into such developments reduce the potential public resources the compact city vision could rely on and discourage the inevestments of private resources into the rehabilitation of brown zones as reduce the demands for such projects (since if more people opt for the suburbs then less people would like to reside in rehabilitated brown areas).

It can be argued that suburban railway in sparsely populated areas are not viable without subsidies, as without subsidies fares would be extremely high. Though this is right, I argue that this cannot justify the existence of suburban railways in such areas, as sparsely populated areas buses are likely to be able to provide mobility services without or with much lower subsidies. And certainly, I do not argue for terminating the railway services within Budapest, where the population is dense enough in most parts or along routes that are parts of the national grid and so serve the passenger and freight transport needs of the whole country. On the other hand, the suburban sections of many routes go through sparsely populated areas and serve primarily the residents living along those routes.

4. What are the public views about the current distribution of subsidies and about potential redistribution of parking subsidies?

This research question aimed to test the 2nd hypothesis that is “most people would prefer the equal or need-based redistribution of mobility-related subsidies”. The findings suggest that around half of the people find the unjust distributions problematic, around a third of them find it fine, and the rest are ignorant or cannot decide. However, most of those who find the distribution problematic consider general subsidy reductions as problematic, too. These somewhat incoherent views suggest that the reduction of public subsidies alone would not have majority support. This finding is in line with the common view, according to which internalization of external costs is unpopular in most cases (Banister 1994).

On the other hand, if subsidy reduction ideas are coupled with justice considerations – that is for example subsidy reductions would be lower in the case of low income people -, then even the majority of those who would be affected by the subsidy reduction would support some limited reduction at least in the case of high-income people. However, as this kind of reduction would primarily affect the high income people, its impact on car domination would be likely to be small, since high income people are probably less influenced by subsidy reduction than others.

Finally, the findings suggest that equal redistribution of parking subsidies would be supported by much more people (around 60%) than being opposed (around 30%). As redistribution would affect everybody who received parking subsidy, and it would entail higher parking subsidy reduction compared to simple subsidy reduction, its impact would be likely to be much larger. That is equal subsidy redistributions are likely to be much more effective in reducing car domination than subsidy reductions.

Certainly, the findings regarding the views of subsidy redistribution apply only to the parking subsidies, in the case of which the size of subsidy is legally determined, the unequal distribution is easily perceivable (residents either receive large subsidies or not), and the number of residents who do not receive any subsidies substantially exceeds the number of residents who receive significant subsidies. The situation might be different in the case of unspecific external cost related and air pollution related subsidies, where the size of subsidy can be disputed, its unequal distribution is less obvious (people receive different amount of subsidies) and the number of people who receive subsidies exceeds the number of people who do not receive subsidies. And though the majority would still benefit financially from the subsidy redistribution, it is less obvious that who would benefit from it and to what extent as it depends on the motorized transport use of the individuals. And regarding public transportation subsidies, it can be assumed that their redistributions are less supported due to the positive social and environmental values associated with public transportation.

The situation is also different in the case of commuting subsidies but in another way. First, though the size of commuting subsidy is legally determined, it is less interpretable as it is tax exemption provided for companies, rather than price reduction provided for commuters. And though it is provided only to a small number of people, it is not obvious that among whom should be they redistributed.

If there is potential public support for subsidy reform why it does not take place? Though the research was not designed to explore this question, based on popular articles addressing subsidy related issues and on reflection of respondents in the surveys I argue that there are the following barriers.

Public unawareness of mobility related subsidies

Public discussions about subsidy reforms affecting large number of people are inevitable for introducing those reforms. As it can be assumed that such public discussions require certain public awareness regarding the extent and current distributions of subsidies, this section aims to explore such awareness on the basis of the textual responses given in the questionnaire.

- *Subsidies related to the external costs of air pollution of car use*

Despite acknowledging the problem of air pollution to some extent, the suggestion that car users currently do not cover the external costs of their car use – that this can therefore be considered as a subsidy of car usage – and that external costs should be internalized, was criticized by many respondents in the textual responses of the first questionnaire. First, some people think that car users pay enough (or even too high) taxes, and they either question the true extent of external costs of car use, or overestimate the revenues collected from car use taxes. The finding of the first questionnaire suggest that around 42% and 13% of car user and carless inner city residents think that car users pay enough fees and/or taxes to cover all costs car use entails, including the external costs of air pollution. Such beliefs might be amplified the misinterpretation of data regarding the contribution of road transport to health harms caused by urban air pollution. For example, both scientific researches and popular articles states that while household heating is responsible for more than the half of PM emissions, the role of transport is only 10-15% (EEA 2016, Tenczer 2017). Nevertheless, the general contribution to PM emission is rather unrelated to the contribution to health harms caused by PM pollution in urban areas for several reasons. First, the relative proportion of transport and heating-related contribution to PM levels is rather different in urban and rural areas, and the proportion of transport is likely to be substantially higher in cities, and particularly in inner cities, because on the one hand transport is concentrated in urban areas, while on the other hand PM generating heating (i.e. coal and biomass) is uncommon. Secondly, while PM generated by heating is usually emitted through chimneys at heights of several meters from where large part of the PM flows up, PM generated by transport is emitted close to the ground where it can mix better with air that people breathe. Thirdly, while heating generates PM only in winter, when people usually spend most of their time indoors where they are protected from outdoor PM pollution to a great extent, transport generates PM all year round, including in seasons when people spend much more time outdoors. Fourthly, transport contributes to PM pollution not only through direct emissions but by reducing the sedimentation of PM through stirring the air continuously. As these issues are not addressed in these articles, the popular belief in Hungary might be that it is primarily space heating that, regardless of the location, contributes to PM-related health harms.

Secondly, some people argue that the negative effects are the consequence of the lack of appropriate administrative policies or their enforcement, such as limiting the use of particularly polluting vehicles, especially in the case of public transportation buses. Though indeed there are many particularly polluting cars and buses in Budapest, on the one hand their actual contribution to air pollution is unknown, while on the other hand even electric cars contribute to the pollution through the abrasion of their tyres and brakes and by stirring up the air. Thus, though the ban on particularly polluting vehicles would be likely to reduce air pollution to a great extent and so it is highly recommended, air pollution would likely still cause significant health harms. Certainly, a complete ban on vehicles with combustion engines would be likely to reduce health harms to a radical extent, but such a ban is likely to be out of the question at least for decades.

Thirdly, some people think that intensive car use is so inherent to inner cities that any internalization of external costs would have minimal effect on the intensity of inner city car use and so on the extent of external costs. This thinking also ignores the possible positive impact of the revenues generated by the internalization that could be used as a potential source to compensate the health harms caused by car use. Fourthly, there is also an opposite view, according to which any internalization of external costs would make most car use impossible, including essential uses such as freight transport or the car use of handymen who need their cars to carry their tools, and so internalization would make urban life impossible. Based on basic economic rules about the relationship between demand and price these views are rather irrational.

- *Public transportation subsidies including commuting subsidies for public transportation*

Public transportation and commuting subsidies are a special case, because while frequent public transportation use by monthly passes is heavily subsidized, particularly in the case of students and pensioners, occasional use is not subsidized at all, but rather overprized, except in the case of suburban public transportation. In addition, the extent of subsidies are different in the different routes, as while within the city subsidies cover around 78-83% of the costs of public transportation, in some routes they cover more than 90% of such costs (see details in Chapter 5). In addition, the subsidy rates are likely to differ within the city, too, as ridership in the inner city routes are likely to be much higher than in outer city routes (Gössling et al. 2019). If the air pollution related external costs of bus use are also considered, the subsidy rate is even higher. It is rather doubtful whether the public is aware of the high proportion of subsidies, particularly in the case of suburban routes, and of the difference between the subsidies of frequent use and the overpricing of occasional use.

Certainly, public transportation subsidies are extremely embedded into modern societies, in the case of which subsidies are natural and so the extent of subsidies of public transportation is rather unpopular.

- *Car use commuting subsidies*

No official public data is available about the extent of commuting subsidies for car use and the tax authority claims that it does not collect such data (email communication). However, based on oral communication within my social network, car use subsidies are commonly available even for those who do not meet its requirements. It is rather doubtful whether the majority of people are aware of the commuting subsidies.

- *Parking subsidies*

Though the legislation of municipalities determines clearly the value of parking subsidies, and their distribution is obviously unequal (as only car users receive it and not every household has a car), based on the many puzzled comments given in the questionnaire survey (e.g. ‘which subsidy, the annual parking permit costs 7 EUR’ or ‘I pay weight tax’) the public is largely unaware of parking subsidies, and consider free residential parking as a right associated with owning a car.

In summary, though it is unknown how aware is the public of the mobility-related subsidies, it can be assumed that such awareness is low as information about public costs are often unavailable or questionable, and reliable information is rarely published in the popular media. As it is rather difficult to initiate a public discussion about issues the public doesn't have at least a basic awareness of, this low awareness is an important barrier to direct public discussions about subsidy reforms. And when there is some awareness about a certain subsidy, that subsidy is perceived self-evident support that has no alternative. Therefore, it is not only important to inform the public of current subsidy levels, but also of alternative policy solutions and their potential impact.

In addition, based on the comments on the articles and the surveys, many people are unaware of not only transport subsidies but also have incomplete knowledge about basic economics and public administration. For instance, the belief that higher mobility prices would have either minimal or extraordinary effects on mobility patterns regardless of the extent of price increase suggests that many people are unaware of the simple relationship between demand and the price of a product or service. The suggestions according to which municipalities should provide much more subsidies to everyone or should finance the off-street parking of residents, suggest that many people have limited knowledge regarding the extent and composition of municipality budgets. Such incomplete knowledge constitutes another barrier to public discussions about subsidies[63].

Administrative barriers

The current subsidies have an important advantage compared to other potential subsidy types: they are tax-free. Thus, while municipalities or the state can provide parking subsidies, public transportation subsidies or subsidies embodied in infrastructure projects, if they provide subsidy e. g. in cash, in coupons for public transportation, or in the form of bicycles, they (or the receivers) are required to pay taxes similarly to taxes paid upon salaries. This administrative rule entails extra costs on subsidy redistributions based on equality and so hinder their implementation.

One example of this problem is the redistribution of driving certificate subsidies into mobility subsidies in the 7th district of Budapest. Students over 16 who reside in the 7th district were previously entitled to free driving training that costs around 500 EUR per student (Municipal Decree of the 7th District 25/2015). As the municipality contracted a training company to do the training, this subsidy was tax-free. In 2020 the municipality changed the legislation and since then students are entitled to a monetary subsidy of around 110 EUR that they can spend on driving training, on bicycles or on scooters. However, as the monetary subsidy qualifies as income, the municipality is required to pay taxes of around 50 EUR per student (personal communication).

Another important administrative barrier in the case of air pollution related subsidies is that inner city residents have little influence on the internalization of air pollution related external costs and on subsidy redistribution for several reasons. First, these issues can be addressed by the municipality of the Budapest who represent the whole population of the capital city. Therefore, though even if the majority of inner city residents were in favour of internalization of environmental external costs, they would be likely by outnumbered by outer city residents who are less interested in such internalization as transport-related air pollution affect them much less than inner city residents and they rely on car use more than inner city residents. Secondly, many municipalities overlap both inner city and outer city areas; therefore, their residents might have conflicting interests, which the decision-makers cannot represent properly. Thirdly, the inner city area is fragmented among different municipalities that makes it difficult to act with one voice. If the number of inner city districts was lower, they covered only inner city areas and they were entitled to

[63] Certainly, part of the citizens might have difficulties to understand and apply these economic concepts to public policies, and so in their case this barrier cannot be reduced. Nevertheless, there are likely many people who could understand these concepts if they were incorporated into educational agendas.

introduce road fees in order to internalize environmental external costs and disposed over the revenues of road fees, then road fees would be more likely to be introduced.

9 CONCLUSIONS

The research demonstrated that mobility-related public costs are extensive in the case of residents and workers of the inner city of Budapest, and that motorized mobility users only pay a fraction of overall mobility costs. If all public costs were regarded as subsidies, then data indicates that the distributions of mobility-related subsidies would be highly unjust as they are highly unequal and are not based on need, since inner city car owners and frequent car users, who have higher than average income, receive much more subsidies than non-car-owners, and people who reside far from their workplaces receive more subsidies than people who reside close to their workplaces despite the lack of difference between their incomes.

These unjust distributions of mobility-related subsidies indicate the possibility of potentially more just subsidy redistributions based on equality or need that would entail significantly higher motorized mobility prices due to the payment for the public costs and the equal or need-based redistributions of subsidies in monetary form. As the price of car use would increase to a greater extent than the price of public transportation, it is unlikely that such redistributions would encourage a shift from public transportation to car use. It is also unlikely that people would spend subsidies on motorized mobility for two reasons. First, the equal or need-based distributions entail that the received monetary financial resources in many cases are smaller than the price increase associated with the same mobility patterns before subsidy redistribution. Second, the price increase has opportunity costs, i.e. if people use more motorized mobility services, they must spend less on other services or goods. Therefore, it is more likely that mobility-related subsidy redistributions would possibly a) encourage people to reside closer to the inner city or subcentres, b) to cycle or use other alternative transport methods instead of motorized transport, c) to switch from car use to public transportation, and d) to rely on carsharing or car rental instead of owning a car.

The research also demonstrated that most people perceive the current subsidy distribution system as unjust, and at least in the case of parking subsidies, would favour redistributions based on equality or need. In addition, findings suggest that if revenues are redistributed equally, then people can accept more significant subsidy reductions – i.e. higher parking fees – than if the revenues are used for public projects. Finally, the research attempted to identify the barriers of subsidy redistributions, including a) a low public awareness on mobility-related subsidies and their distribution, b) incomplete public knowledge on basic economic principles, c) tax requirements of monetary subsidies and d) a lack of agency of inner city communities to require compensation for the external costs they must endure.

Based on these findings, the primary policy-related conclusion of the research is that revenue recycling policies, which are applied so far only in the case of nationally or regionally levied environmental taxes, should be framed in a distributive justice context and should be extended to parking fees and urban road fees, commuting subsidy reductions and public transportation fares. As conventional revenue recycling is not possible in the case of urban areas as they do not collect individual taxes, and as subsidy redistributions are more just than tax reductions, revenues should be distributed in monetary forms equally or based on need. The easiest target of a subsidy distribution reform is the current parking subsidy, the value of which is legally determined, which is distributed obviously in an unequal manner, and which could be financially beneficial to the majority of inner-city residents. Besides parking subsidies, the redistribution of mobility-related subsidies might be applied to commuting subsidies, too, as commuting subsidies are particularly unjust and affect only relatively few people. The redistribution of other subsidies, however might require the need to address barriers of potential subsidy reforms.

The research also explored some knowledge gaps that should be addressed in order to facilitate subsidy reforms. Some of the knowledge gaps relates to the quantification of subsidies. First, the contribution of car use to the external costs of air pollution is highly uncertain. Currently it is considered that the contribution to the external costs of air pollution is equal to the contribution to air pollution that is likely to be incorrect as the external cost of air pollution is not proportional to the level of air pollution in general, but to the level of air pollution in the air people breathe in. As indoor air pollution is much lower than outdoor air pollution and as people spend more time outdoor from spring to autumn, when the relative contribution of car use to air pollution is higher than in the whole year (since from spring to autumn the contribution of heating is lower due to the less heating), the actual contribution of car use to air pollution-related external costs is likely to be higher than usually considered. In addition, the extent of contribution of car use to air pollution is also contested, as the relative shares of cars, buses and trucks, are uncertain, and car use pollute the air by stirring it up, too. Finally, the extent to which cars with different environmental standards contribute to air pollution is also an area where limited research has been done to date.

Another knowledge gap of quantification relates to the value of road space and parking space that would be necessary to determine the public costs of public space consumption of car use. Currently only the parking space has an official value, but even that could be contested, as that value obviously depends on the extent of parking space which could be smaller or larger. And regarding road space, car users use it for fee, despite it occupies more public space than parking. Finally, a further quantification-related knowledge gap relates to the infrastructural costs related to different travel modes. As in the case of public transportation most of these costs are usually not included in the annual budgets, they are not considered as public subsidies. And though in the case of car use, car users pay the cost of infrastructure through the levies placed on the price of fuel, the extent to which the revenues from such levies cover the cost of infrastructure is largely unknown. And due to this knowledge gap, in the case of cycling it is only an assumption that the health benefits of cycling exceed the costs of cycling infrastructure.

The research also revealed some controversial attitudes to redistribution schemes and to justice, e.g. the negative attitudes of non-car-owners to redistribution policies that would benefit them both directly and indirectly, that might further explored by indepth qualitative interviews.

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Table 18. The place of residence – workplace matrix of Budapest. Yellow cells refer to potential through trips.

District of residence	District of workplace																				
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XX.
I.	3,896	571	435	105	761	313	245	449	396	149	808	485	570	272	51	33	19	61	36	38	4
II.	928	15,549	1,713	366	2,402	1,170	750	1,270	1,205	529	2,200	1,396	2,170	951	165	109	60	175	118	91	11
III.	932	2,583	23,917	1,039	2,610	1,415	1,052	1,804	1,666	1,105	2,859	1,347	4,314	1,700	502	218	129	308	170	154	19
IV.	512	1,306	1,811	16,662	2,003	1,266	959	1,527	1,457	1,180	1,844	672	5,278	1,847	1,734	337	166	300	211	120	16
V.	183	333	307	131	5,307	361	292	428	427	188	572	229	663	329	75	49	27	64	53	37	5
VI.	273	697	588	268	1,150	6,992	664	724	731	439	1,020	397	1,319	691	193	105	58	161	87	87	8
VII.	375	836	753	437	1,452	1,143	9,380	1,317	1,187	691	1,481	610	1,695	1,175	247	189	98	191	104	117	14
VIII.	444	971	946	481	1,672	1,055	1,024	13,597	1,759	1,096	1,979	712	1,941	1,207	289	211	132	353	224	205	23
IX.	417	894	794	364	1,694	881	732	1,500	10,713	973	2,265	580	1,954	918	173	140	77	434	277	277	32
X.	349	788	780	469	1,270	749	737	1,979	1,602	14,340	1,485	521	2,004	1,714	449	489	384	803	457	278	26
XI.	1,115	1,925	1,633	524	3,123	1,328	1,223	2,085	2,673	1,237	27,545	2,087	3,094	1,482	291	207	116	362	242	223	39
XII.	726	1,268	850	181	1,534	697	456	816	880	373	1,958	9,469	1,252	541	106	73	42	99	67	64	9
XIII.	750	1,937	2,465	1,574	3,199	1,952	1,372	2,153	2,147	1,431	2,878	1,078	24,558	2,168	793	274	157	463	225	185	28
XIV.	771	1,619	1,697	907	2,937	1,705	1,460	2,372	2,202	2,340	2,828	1,024	4,190	21,838	1,170	760	302	536	241	194	26
XV.	339	760	1,007	1,889	1,257	879	779	1,287	1,024	1,109	1,236	447	2,567	2,374	12,541	536	181	226	159	110	14
XVI.	309	658	724	503	1,217	661	690	1,092	947	1,590	1,114	386	1,861	2,250	879	10,872	360	341	160	107	11
XVII.	300	709	637	413	1,183	743	676	1,264	1,252	3,491	1,239	430	1,813	1,825	413	1,014	12,864	1,052	419	243	19
XVIII.	357	731	738	366	1,477	794	658	1,509	2,058	2,468	1,695	460	1,956	1,220	250	274	346	16,511	1,504	838	40
XIX.	282	552	549	266	1,057	590	480	1,304	1,539	1,665	1,242	321	1,385	874	184	146	157	1,288	8,295	520	33
XX.	251	524	476	269	900	529	530	951	1,911	1,213	1,510	336	1,351	741	186	142	107	672	640	9,066	92
XXI.	275	653	532	303	1,140	643	543	1,152	1,997	928	1,961	450	1,539	752	185	118	86	465	376	1,031	12,49
XXII.	291	470	446	148	742	382	344	634	824	405	3,509	522	828	476	100	52	45	133	87	86	26
XXIII.	73	143	115	59	260	163	125	276	536	304	358	91	376	217	51	32	34	262	162	655	24
Other settlement	4,590	11,007	14,234	8,779	16,178	9,420	8,008	14,234	15,803	15,544	22,780	8,457	23,654	12,695	5,253	4,050	3,570	7,385	3,110	3,384	5,22
All together	18,738	47,484	58,147	36,503	56,525	35,831	33,179	55,724	56,936	54,788	88,366	32,507	92,332	60,257	26,280	20,430	19,517	32,645	17,424	18,110	23,01