Car sharing and socio-spatial injustice

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SPACES OF DIALOG
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Fostering the European
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TÉCNICO LISBOA

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Editors: Eduarda Marques da Costa; Sofia Morgado; João Cabral
With: José Antunes Ferreira; José Manuel Simões; Isabel Loupa Ramos; Jorge Batista e Silva; Miguel Baptista-Bastos; Paulo Silva
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From one of the most western cities in Europe we believe that we may address potential European urban futures and the need for opening effective dialogue and cooperation with other corners of the globe.

We look forward to welcoming you in Lisbon and engaging with you in discussing these challenges.

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ID 1542 | CAR SHARING AND SOCIO-SPATIAL INJUSTICE

Elena Pede[1]; Luca Staricco[1]
[1]Politecnico di Torino
elena.pede@polito.it; luca.staricco@polito.it

1 INTRODUCTION

Car sharing is nowadays commonly acknowledged as an innovative approach to the transportation problems of urban areas (Firnkorn and Müller, 2015). Scientific literature regularly discusses car sharing related to the context of sustainable mobility and environmental benefits, or in relation to consumer behaviours in the sharing economy rhetoric. The former approach is common in transport studies and concerns strategies to face mobility-related problems in urban context and potential solutions for the environmental impacts of car traffic due to CO2 emissions (Martin and Shaheen, 2011), number of vehicles per household (Martin et al., 2010) and vehicle-kilometres travelled (Firnkorn, 2012). On the other side, social studies are more interested in the changes of consumer behaviour and their implications on society and economy. These publications are mostly based on the shift from ownership to service use lifestyles (Kuhnimhof et al., 2011; Prettenthaler and Steininger, 1999; Schaefers, 2013): the concept of ownership is changing fast and determining lots of consequences on consumers' practices and business strategies (as, for example, the interest of auto companies in short-term rental like a way to balance the loss of purchases; Schwanen, 2016a).

Differently, poor attention has been so far focused in scientific literature to the social impacts of car sharing. This can sound quite surprising: the first car sharing organisation, the SEFAGE (Selbstfahrgemeinschaft, self-riding community), was founded in 1948 in Zürich by a housing co-operative, just to allow people, who could not afford to purchase an own car, to share one (Harms and Truffer, 1998). Shaheen and Cohen (2007) outlines that the main beneficial social impact of car sharing is the possibility for households (in particular, low-income ones) to gain or maintain vehicle access without bearing the full costs of car ownership. Litman (2000) reads it in terms of equity: car sharing can increase equity by improving the mobility options of people who are transportation disadvantaged.

But the spatial dimension can play a crucial role for these supposed social benefits, in particular in urban areas. On the one hand, the distribution of social deprivation problems in the city is not homogeneous, on the contrary it tends to increasingly polarize (especially in times of austerity and economic crisis; Cucca and Ranci, eds., 2016). On the other hand, car sharing services hardly cover all the territory of a city; private companies can choose the area where to operate, or can modulate costs and levels of service (e.g., the density of stations) in different neighbourhood of the same city. If these two spatial distribution patterns mismatch, car sharing can deepen rather than reduce socio-spatial injustice and inequity

As regards the spatial dimension of car sharing services, until now scientific literature has mainly focused its attention on models and tools to assess the market potential for new car-sharing operations in urban communities (Habib et al., 2012). For example, Celsor and Millard-Ball (2007) developed a methodology that supports car-sharing operators and transit agencies to assess the market potential for car sharing in different neighborhoods, according to their characteristics. Wagner et al. (2016) use a set of indicators for the attractiveness of certain areas (based on points of interest in their vicinity, such as shopping malls, movie theatres, train stations etc.) to identify promising regions for an expansion of car sharing business areas. However, the potential negative impacts of these approaches in terms of social inequity have not been considered.

Conversely, in this paper we will try to examine precisely if present car sharing services increase or reduce socio-spatial injustice. The paper focuses on three Italian cities (Turin, Milan and Rome), where private transport plays a key role in mobility choices of citizens (section 2). A deprivation index is calculated to identify in each city the neighbourhoods where potential car sharing benefits could be more significant, and levels of car sharing service are assessed in each of these neighbourhood (section 3). Positive or negative correlations between levels of deprivation and car sharing services are then calculated (section 4), and reasons for these results are hypothesised and discusses (section 5).

2 CASE STUDIES

In Italy, private motorized transport plays a key role in mobility choices of citizens: (its modal share is close to 70%; Isfort, 2016) and the Country has the highest motorization rate in EU, after Luxemburg and Malta, with 610 cars per 1,000 inhabitants. At the same time, road traffic is one of the main problems in urban areas in terms of air and noise pollution emissions, loss of public space, reduced efficiency of surface public transport. Despite these critical situation related to private transport, the diffusion of car sharing services inside most important Italian cities was considered, since the beginning, a potential advantage for solving mobility problems and an innovative “ethic” perspective of mobility (Fistola, 2007). Nowadays, car sharing is spreading quickly, especially in Northern Italy, whereas is less widespread in the South.

The first car sharing services started at the end of the 90’s thanks to the national Car Sharing Initiative (ICS) promoted by the Ministry of Environment, that financed station-based services in 12 cities and 4 provinces at the beginning of 2000s. Since 2013, several private free-floating services were set up in main urban areas, followed also by van and scooter sharing. The introduction of free-floating services is reducing the number of users of station-based services, which are more expensive and less flexible. At the same time, new types of station-based and free-floating services are emerging related to electric vehicles.

The case study analysis takes into account three of the four Italian cities with the highest number of inhabitants: Rome, Milan, and Turin. They have different types of car sharing services and more than one company interested to operate in this service (Table 1). Naples (the third city per population) was not considered because it has only one company that operates with a very limited car sharing services (only 4 stations in the whole city). Rome, Milan and Turin have both station-based and free-floating services. In general, each city has its public (station-based) car sharing initiative even if some of them have a limited number of cars or the service has stopped because of the high decreasing of customers. On the contrary, free floating mainly concerns private companies whose numbers of cars, costumers and services are increasing rapidly in the last 4 years.

Station-based services			
	number of car services	number of scooter services	number of electric vehicles
Rome	1	-	-
Milan	3	-	2
Turin	2	-	1
Free-floating services			
	number of car services	number of scooter services	number of electric vehicles
Rome	3	5	3
Milan	4	1	2
Turin	2	-	-

Table 2 – Details of the car sharing services analysed in the three cities

At the same time, it is important to consider the different dimensions, densities and spatial structures of Rome, Milan and Turin (Figure 1), which can influence the implementation strategies of car sharing companies.

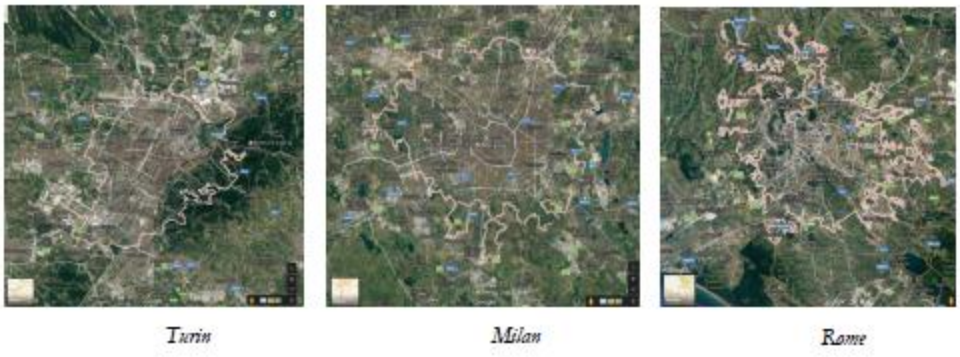


Figure 1 – Spatial structure of the three case studies

Rome is the largest and most populated Italian city (and the fourth-most populated one in the European Union) with 2.873.598 residents (2016) on 1.285 square kilometres. Its urban boundaries are wide due to historical reasons: its surface is six times the size of Milan. Its territory is divided between highly urbanised areas, parks, natural reserves, rural areas, wetlands. The transport infrastructure is bases on the radial network of roads that connected, already at the time of the Roman empire, the city with its surrounding region. Nowadays, Rome is cut in two parts by the Grande Raccordo Anulare (GRA), a ring-road that circles the city centre with a radius of about 10 km. Most inhabited areas lay inside the GRA, but there are also neighbourhoods outside of it and also up onto the Tyrrhenian coast (20 km far from the city centre). The city suffers from chronic road congestion, also because of the limited size of Rome's metro system (two underground lines) compared to other cities of similar size. Due to poor efficiency of public transport, citizens have become addicted to private vehicles and the ring-road has become the main transport infrastructure. Today the city has one of the highest motorized vehicle ownership rate in Europe: 613 cars every 1,000 inhabitants.

Milan is the second most populated city in Italy with 1,369,000 people in the proper city and 3,209,000 in the metropolitan area (2016). Its territory covers 181 square kilometres with a population density of 7.315 inhabitants per square kilometres. The urbanized area covers almost the entire city surface and has swallowed many municipalities of the metropolitan area, especially in the North. The city has a concentric layout and the public transport network consists of five underground lines and 154 surface bus and tram lines. Also in Milan, mobility problems are related to the private transport demand, due to the high number of people entering the city during the day and the absence of co-ordinated mobility management at the metropolitan level between the city and its hinterland. A congestion charging scheme has been introduced in 2011 in the central part of the city.

Turin counts 888,921 inhabitants (2016) and covers 130 square kilometres. The city has a natural limit on the Eastern front, where it is surrounded by high hills. On the Northern and Western fronts the urbanized area spreads far beyond the city limits and covers several municipalities up to the Alpine mountains, while the Southern front is wider due to the plain territory. The city has grown along the North- South railway axis that used to cut the territory in two parts; this trench was covered in the 90s and its transformation has allowed to build a 8-lines commuter rail system that connects the city to its metropolitan area. The public transport network consists of one underground line and several surface bus lines. Nevertheless, also in Turin private transport plays a leading role in citizens' choices of mobility.

These transport and morphological structures have influenced the car sharing models adopted in each city. For example, due to severe congestion problems, in Rome 5 companies were or are specialized in scooter sharing services. In the cases of Rome and Milan, the municipalities required to the companies to serve specific areas, while in Turin there is not specific demands (even if Eastern hills are not served because of their poor residential density and difficult accessibility). Rome limited the services to the region inside of the ring road (GRA) even if some of the companies have showed an interest in serving also parts of the surface outside the GRA, especially the coast during summer season. On the contrary, the municipality of Milan tried to impose spatial equity elements requiring to cover a certain percentage of the

municipal surface. As a consequence, one of the company operating in the city (Car2Go) has introduced an additional cost for outskirt zones because they registered a low utilization of the cars and the relocation of the vehicles by the company was considered non- economic.

In this paper, we will focus on the three car sharing services that are active in each of the three cities (Table 2): the already mentioned station-based ICS service, promoted by the State, and two private free-floating services, Enjoy (promoted by the Italian oil company ENI) and Car2go (promoted by the Dutch automotive Daimler group).

	Turin	Milan	Rome
ICS: number of station	67	84	131
Enjoy: operational area (square kilometres)	49	118	97
Car2go: operational area (square kilometres)	56	117	90

Table 2 – Details of the car sharing services analysed in the three cities

3 METHODOLOGY

3.1 DEPRIVATION INDEX

Data above driving licences of car ownership at sub-municipal neighbourhood level are not available for Italian cities. We have decided to use, as a proxy for these, a social deprivation index: the assumption is that people that cannot afford to own a car are more likely to live in neighbourhood where social conditions are worse, rather than in more richer ones. Therefore, a deprivation index (ID) was calculated for each census tract[1] of the three cities. The index is made up of four distinct indicators of social deprivation, for which disaggregated data at the census tract level were available from 2011 population census. These indicators are:

- Education (z1): percentage of people aged 15 years and over which has attained at maximum a primary or lower secondary level of education;
- Unemployment (z2): percentage of people aged 15 years and over which is unemployed;
- Living condition – overcrowding rate (z3): average number of people per dwelling;
- Living condition – housing condition (z4): percentage of people living in mediocre or poor condition houses.

For each indicator z, census tract variables x are standardized by subtracting the city mean μx and dividing the difference by the standard deviation σx:

$$z_j = \frac{x_j - \mu_{x_j}}{\sigma_{x_j}}$$

The deprivation index of each census tract is then calculated as the sum of the four indicators:

$$I_D = \sum_{i=1}^{4} z_i$$

On the basis of the deprivation index values, census tracts are finally clustered in five “deprivation classes” through the Jenks natural breaks method, where “class 1” comprises the least deprived tracts and “class 5” the most deprived ones.

[1] The census tracts referred in this paper are the so-called ACE (“aree di censimento”), which are defined by the Italian national statistics Institute as municipality partitions hosting between 13.000 and 18.000 inhabitants.

3.2 LEVELS OF CAR SHARING SERVICE

For station-based car sharing services, each station is geo-referred and "attributed" to the census tract it is located inside. Two indicators are then calculated for each census tract:

- the absolute number of car sharing stations;
- the density of car sharing stations (i.e., the number of stations divided by the number of residents).

For free-floating car sharing services, the border of the operational area covered by the service is geo-referred, and census tracts (with their number of inhabitants) inside and outside this border are identified; the same is done for borders which separate operational areas covered by different service tariffs. If a census tract is partly inside and partly outside this border, the tract is divided in two sub-tracts and its total population is attributed to these portions proportionally to their surface. An indicator is calculated to measure the percentage of population living in census tracts that are covered by the car sharing service, and the percentage that is not served; in the case of diversified tariffs, the percentage of population covered by each tariff is calculated.

4 EMPIRICAL RESULTS

4.1 DEPRIVATION INDEX

Table 3 shows the mean values and the standard deviation of the four deprivation indicators for each of the three cities, as well as the range of values for the five classes of the derived deprivation index.

	Turin	Milan	Rome
N° of census tracts	57	86	147
ID dimensions			
Education			
mean value	0,230	0,186	0,187
standard deviation	0,053	0,052	0,058
Unemployment			
mean value	0,071	0,054	0,064
standard deviation	0,016	0,013	0,014
Overcrowding rate			
mean value	2,140	2,065	2,302
standard deviation	0,159	0,143	0,217
Housing conditions			
mean value	0,122	0,096	0,123
standard deviation	0,074	0,069	0,099
ID classes			
1	-4,95 – -2,89	-4,27 – -3,04	-5,25 – -2,83
2	-2,89 – -1,22	-3,04 – -1,44	-2,83 – -0,67
3	-1,22 – 0,35	-1,44 – 0,30	-0,67 – 1,38
4	0,35 – 2,70	0,30 – 3,00	1,38 – 3,75
5	2,79 – 8, 02	3,00 – 9,95	3,75 – 8,31

Table 3 – Details of the deprivation index in the three cities

Population is quite homogeneously distributed (Figure 2) among the five deprivation classes in Milan and Rome, despite classes 4 and 5 cover over the half (76% in Rome) of the municipality surface. In Turin residents are more concentrated in the first and in the two last classes.

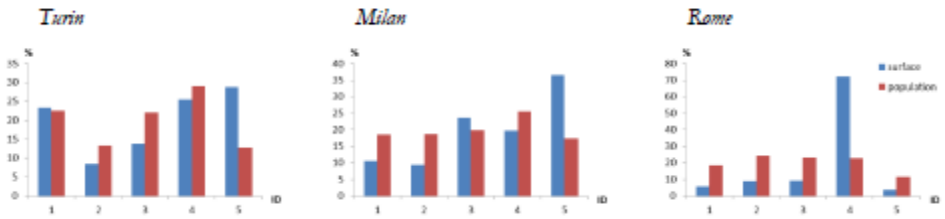


Figure 2 – Distribution of population and surface among the five classes of the deprivation index

Conversely, from a spatial point of view, the distribution of the census tracts among the five deprivation classes is quite far from being homogeneous. As shown in Figure 3, in all the three cities deprivation levels generally tend to increase from the central area to the outskirts. In the case of Turin, less deprived areas are concentrated in the Northern part of the city and in the Eastern hills; in Milan, they cover the Western and Southern outskirts; in Rome, a wide deprivation “class 4” area surround the central city, while “class 5” census tracts are quite restricted in surface.

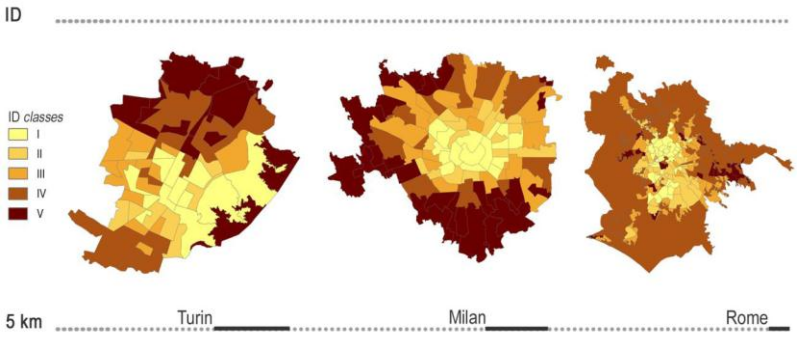
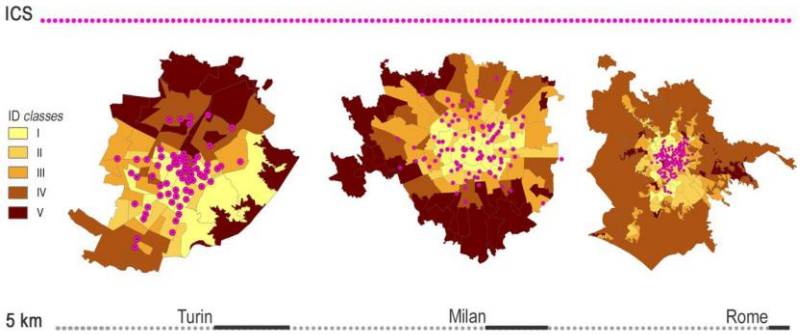


Figure 3 – Spatial distribution of the five classes of the deprivation index in Turin, Milan and Rome

4.2 STATION-BASED CAR SHARING SERVICES

In all the three cities, it is clearly evident (Figure 4) that the level of station-based car sharing service decreases significantly from less deprived areas to more deprived ones, either considering as service level the absolute number of stations in each class or their density (n° of station / inhabitants ratio). For example, in Turin 55% of stations are concentrated in census tracts of the first deprivation class. In all the three cities, two thirds of the stations or over are located in the census tracts of the two less deprived classes.



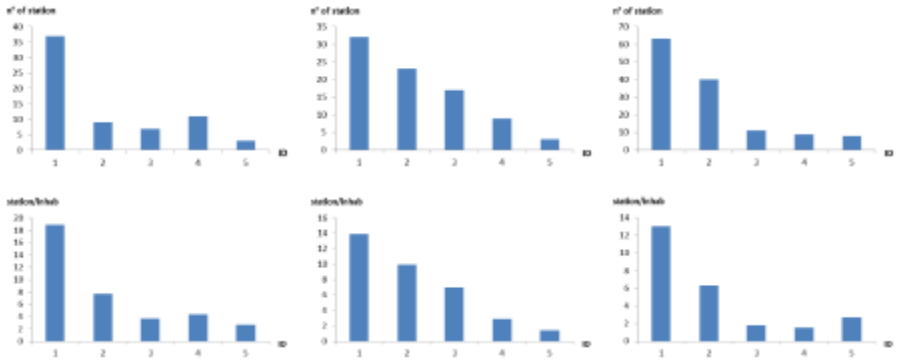


Figure 4 – Number and density of the fixed car sharing stations

4.3 FREE FLOATING CAR SHARING SERVICES

As regards Enjoy (Figure 5), the percentage of the population living in census tracts covered by the service decreases from less deprived tracts to more deprived ones (except in Rome, where population in the tracts of the fifth deprivation class is more served than in the fourth class). In Milan, the coverage range from 100% for the first class of deprivation to 74% for the fifth class; in Turin from 81% to 50%; in Rome, 83% of the population in the first deprivation class is served, but only 5% in the fourth class and 16% in the third and fifth classes.

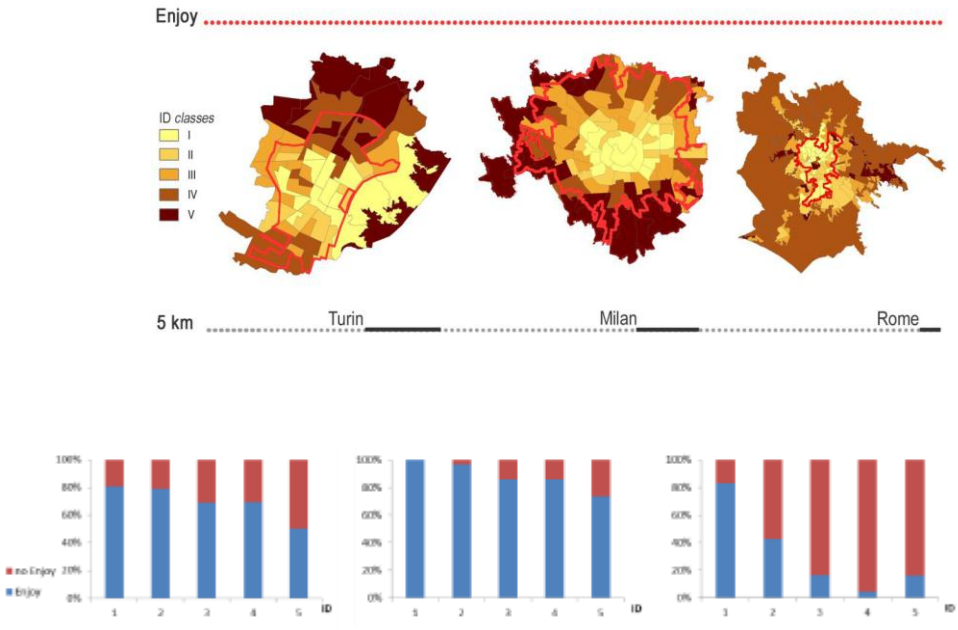


Figure 5 – Percentage of the population living in census tracts covered by the Enjoy car sharing service

As regards Car2go (Figure 6), a similar uneven spatial coverage of the service can be noted. In Rome, 76% of the population in the first deprivation class is served, compared to 6-7% in the fourth and fifth classes. In Milan, where the service has a dual tariff, in the first two classes over 95% of the residents are served by the less expensive tariff; in the fifth class, only 6% of the residents live in a census tract covered by this tariff, 61% are covered by the more expensive tariff and 33% are not served at all. In Turin the decreasing level of the service is less clean but anyway acknowledgeable: the coverage reaches 86% of the population for the second deprivation class, and only 65% in the fifth class.

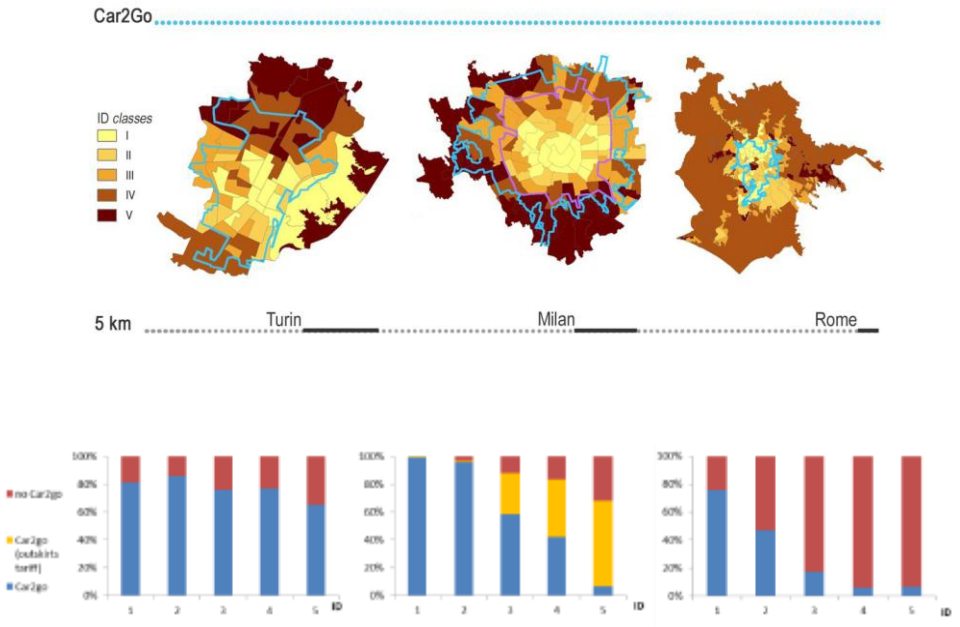


Figure 6 – Percentage of the population living in census tracts covered by the Car2go car sharing service

5 DISCUSSION AND FUTURE RESEARCH

The importance of transportation in spatial justice issue is still hardly considered (Martens, 2016) even if transportation systems, for their very nature, influence the urban structure and affect the accessibility from and to a specific place. For example, Schwanen (2016b) wonders whether the reconstitution of public transport as efficient and economical in neoliberal and post-neoliberal cities has reduced or intensified socio-spatial polarization.

Car sharing could be thought as a factor that improves socio-spatial justice and transport equity, since it offers people, who cannot afford to own a car, the opportunity to drive more or less occasionally. But the results of the analysis of car sharing services in three Italian cities clearly demonstrate that, because of their spatial distribution, these services (be they station-based or free floating) increase – at least in relative terms – social and spatial polarization in the city, rather than reduce it. As a matter of fact, in Turin, Milan and Rome car sharing is less developed in most deprived urban areas (where a greater share of residents is likely not to be able to own a car) than in less deprived tracts. In other words, car sharing services tend to give precedence to central urban areas, while most deprived tracts are mainly concentrated in the outskirts.

As Soja (2011) outlines, it is relatively easy to discover examples of spatial injustice descriptively, but it is much more difficult to identify and understand the underlying processes producing unjust geographies. In this paper, we do not examine the strategies that car sharing operators adopt in defining the spatial distribution and extent of their services. A few hypothesis can be done. As some studies have outlined, car sharing users are mainly urban, young and professional: they tend to be in their 30s or 40s, have middle-to higher-incomes, are primarily employed in professional occupation, live in one-person households (Bardhi and Eckhardt, 2012; Katzev, 2003; Millard-Ball, 2005; Schmöller et al., 2015). In order to maximize their profits, private companies can decide to intensify their car sharing services where this kind of potential users are more concentrated (tipically, central urban areas), to the detriment of other areas (as the most deprived ones). Other studies (Celsor and Millard-Ball, 2007) show that car sharing has success in places where transit and walking are realistic alternatives, where a car is not needed for everyday travel and little off-street parking is available: again, these are typically central older, historic neighbourhoods. Finally, private operators can avoid to serve (or reduce their levels of services in) most deprived areas for fear acts of vandalism: for example, in Italy Car2Go allows to rent its cars in a city and park them in another one, but prohibits to drive them in the South of Italy.

Further research on the spatial strategies that car sharing operators adopt in defining their services could help to better understand the reasons of the socio-spatial injustice that car sharing can determine. Moreover, they could offer relevant information to public administration that aims at encouraging car-sharing operators to place their cars in low-income neighbourhoods (through co-funding, subsidies for households etc.) (Millard-Ball, 2005).

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ID 1548 | UNSUSTAINABLE GROWTH OF URBAN TRANSPORT: QUESTIONING MAINSTREAM SUSTAINABILITY SOLUTIONS FOR TURKISH CITIES

Cihan Erçetin[1]
[1]Middle East Technical University
cihanercetin@gmail.com

1 INTRODUCTION

The automobile, supported by bus, has become the transportation mode which formed the urban physical structure after the beginning of the years of Second World War. By this technology, it was possible for the city to develop in any direction. Initially, urban development occurred between train lines, and then the cities started to develop fifty kilometers away from the central core for the average half-hour journey (Newman & Kenworthy, 1999). When the effects of car dependence are considered in urban areas in terms of sustainability concerns for the future of environment, society and economy, it is obvious that an automobile based urban pattern cannot be sustained.

As opposed to car dependency, mainstream solutions are put forth as public transport, walking and cycling. In addition, decreasing policies for car use such as congestion charging, traffic calming, disincentive tax measures for car entrances to city centers and awareness raising campaigns and policies have been seen as supplementary solutions to sustain the future of urban transport. The positive feed backs of those mainstream sustainability solutions have been observed in positive manner over years in especially U.S and Europe –in cycling friendly cities such as Copenhagen, Amsterdam, Strasbourg, Antwerp-. However, cities in Turkey has still been experiencing the hazardous outcomes of car dependency and unsustainable urban transport. Whether the policies has been taken consciously or unconsciously concerning making urban transport more sustainable, there have also been several sustainable solutions in particularly public transport in Turkish cities. These are new urban rail investments, pedestrianization projects, cycling lanes and bike-sharing systems. Therefore, the main question is that "Have sustainability precautions worked so far in cities in Turkey or not?"

In this research, firstly, unsustainable transport concept will be mentioned together with its sustainable solutions as public transport walking and cycling. Then, unsustainable urban transport, namely car dependency, in Turkey will be revealed to constitute a base for research question. Finally, sustainable transport solutions in cities of Turkey will be critically discussed concerning the effects of new public