Evaluating the spatial and social equity effects of road pricing in the European urban context: the Madrid Metropolitan Area.

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ABSTRACT

The paper explores the spatial and social impacts arising from implementation of a road-pricing scheme in the Madrid Metropolitan Area (MMA). Our analytical focus is on understanding the effects of the scheme on the transport accessibility of different social groups within the MMA. We define an evaluation framework to appraise the accessibility of different districts within the MMA in terms of the actual and perceived cost of using the road infrastructure ‘before’ and ‘after’ the implementation of the scheme. The framework was developed using quantitative survey data and qualitative data from focus group discussions with residents.

We then simulated user behaviors (mode and route choice) based on the empirical evidence from a travel demand model for the MMA. The results from our simulation model demonstrated that implementation of the toll on the orbital metropolitan motorways (M40, M30, for example) decreases accessibility most in the districts where there are no viable public transport alternatives. Our key finding is that the economic burden of the road-pricing scheme particularly affects unskilled and lower income individuals living in the south of the MMA. Consequently lower income people reduce their use of tolled roads and have to find new arrangements for these trips: i.e. switch to the public transport, spend double the time for their commuter trips or stay at home.

The results of our research could be applicable more widely for anyone wishing to better understand the important relationship between increased transport cost and social equity, especially where there is an intention to introduce similar road-pricing schemes within the urban context.
INRODUCTION

Understanding the accessibility outcomes of transport policies and investments is becoming increasingly important for planning and development of transport networks in both the local and regional contexts. The current state-of-the-art and best practice for transport accessibility analysis is moving towards the definition of measures of the (in)equality of access to the transport system and accessibility to key life activities and opportunities (e.g. 1, 2, 3, 4).

Our analytical focus for this paper centers on how transport systems and access to them determines the participation of different social groups in everyday activities and/or can lead to their possible social exclusion (5). In this context, social exclusion is understood as a dynamic and inter-relational problem, which emphasizes the importance of ensuring that individuals are able to fully participate in the key economic, social and political activities of the societies in which they live in order to maintain a good quality of life (ibid). This conceptual framing has consequences from a transport perspective, enriching the accessibility paradigm to put considerations of spatial and social equity at the heart of transport decision-making.

Until now social equity considerations have not generally been well embedded within transport decision-making outside of the North America context. Even in the US, the primary focus for such research has tended towards assessments of the environmental justice of major infrastructure projects and less on accessibility evaluation (6, 7) for a more comprehensive overview of the relevant literatures, although there have been some notable exceptions in recent years where wider accessibility criteria have been included (e.g. 8, 4). Our own research is located within the European urban context, where much less attention has been paid to social equity assessment within mainstream transport policy evaluation.

The underpinning European policy goal is that all European citizens to be connected to public or private transport infrastructure and not be disconnected from key activity destinations against their will (1). Our paper contributes to this line of research enquiry by attempting to make evident the relationship between access to transport infrastructures and service and social exclusion more explicit. In particular, the goal of the paper is to better understand the transport inequalities that arise from the introduction of a metropolitan road-pricing scheme. In particular, we make the distinction between different degrees of (in)accessibility to the transport system by different social groups, living in different geographical locations, including consideration of latent or suppressed demand. This requires bringing together accessibility distribution measures and travel behavior modeling and analysis with qualitative data to understand both actual and perceived constraints to different transportation infrastructures and services.

The research described in this paper is based on a case study of the Madrid Metropolitan Area (MMA). Specifically, we have analysed different quantitative and qualitative datasets relevant to an assessment of the consequences of implementing the MMA road-pricing scheme to evaluate how this affects access to, and use of, the public
and private transport network in two low-income districts in the south of the MMA (Getafe and Leganés). More specifically, we compared quantitative travel demand model results before and after implementing a toll-ring scheme with qualitative data from focus group discussions with local residents to evaluate the effects of the scheme on their use of private and public transport systems.

Our research is in response to an urgent described need to develop new socio-political conceptualizations of accessibility in the context of the dynamic emerging human geographies of cities (9, 1). Transport, land use planners and other stakeholders that have a role in shaping urban form, but they need new and improved methods and tools for incorporating differential accessibility outcomes from transport investments and interventions in the process of their plan preparation and policy development. This can also help to encouraging more sustainable patterns of travel in our cities by moving away from current mobility-oriented to accessibility-based goals for urban transport systems (10).

We have chosen the implementation of a road pricing policy in MMA as the focus for our enquiry because we can pre-determine with a degree of certainty that this has the potential to worsen the accessibility of poorer residents (11, 12). As the Dresden (Germany) commuter pricing scheme has demonstrated, in the absence of any recycling of toll revenues (and their explicit re-direction towards low-income travelers) transport benefits in the city will be more unequally distributed after the introduction of a road pricing toll (13). Adopting the hypothesis of affordability, we can conclude that in the lower income urban areas the implementation of a road pricing produces and increasing disparities in the access to a road networked infrastructure with a higher burden on the low income users.

The paper is organized in five sections. The second section—after this introduction—provides a background literature review of the theories and concepts of that describing the interface between transport and accessibility, on the one hand, and social inclusion/exclusion on the other. Section three, describes the methodology we devised to estimate the risk of social exclusion for individuals arising from their accessibility problems. In section four, we discuss the results of the simulation model concerning transport-related exclusion in terms of their (in) accessibility to key activities, differentiated by income and social status. The fifth section offers conclusions about the implications of transport policies (fare and pricing policies) in terms of social exclusion.

**A LITERATURE REVIEW ON TRANSPORT ACCESSIBILITY AND SOCIAL EXCLUSION**

In the transportation field, the notion of the accessibility can be related to two key dimensions: i) ‘spatial’ i.e. relating to the location of housing, work, leisure and consumption locations and ii) ‘financial’ i.e. linked to the generalized costs, money and time budgets spent on travel (14). In the context of a developed city such as the MMA, the literature identifies a number of potential indicators of spatial accessibility, including the proportion of individuals in the population who are within X minutes walking distance of a bus service, or the proportion of people who are within X minutes
from a determined service, by public transport. Church et al. (15) adopt a cut-off value of 400 meters for their buffers to measure the accessibility to a transport system. Kwan (16) defines a number of cumulative opportunities indicators based on 20-, 30- and 40-minute trips.

In terms of financial accessibility, the literature focuses on how much individuals spend in order to access and use the transport system, which can be also proportionately represented in terms of their monthly or annual income. In the development context, Salon and Gulyani (17) have statistically demonstrated poverty to be strongly negatively correlated with the use of motorized transport. The authors identify that affordability is key to the transport poverty of people living in the townships of Nairobi. Although certainly less dramatic, the situation in developed European cities presents an interesting parallel with that described for developing countries. Almost every National Travel Survey (NTS) across the Western world identifies significant inequalities in the travel patterns and access to transport of lower income populations in comparison to their higher income counterparts, and consequently to key economic and social activities (e.g. work, personal business, education, shopping, leisure, etc.).

In particular, this phenomenon is worsened by a spatial mismatch- between the workplaces location and workers location (3, 18, 19). For example, car dependency has rapidly increased for lower skilled and lower income people in European cities like London, Paris and Madrid. This is due to the simultaneous dispersal towards of both workers’ home locations (in their search for more affordable housing) and their employment locations (due to the flight of jobs from city centres and the fragmentation of employment activities) (20, 21).

Banister (22) has argued that in this way, ‘while the impact of road pricing on all travelers is progressive, the impact on low income car owners is regressive’; i.e. it affects more the lower income people. In fact, Davezies (23) shows how currently lower income urban inhabitants tend to cross-subsidize rural infrastructures and services and thus, indirectly, pay for the privileges of higher income inhabitants, even in Spain where a long-term pattern of regional income inequality is showed (24). This kind of unintentional policy consequence increases the problem of social exclusion, which is predominantly an urban phenomenon.

Recently the transport literature has considered not only the income affordability and the consequent re-distributional effects of road pricing schemes, but also time budget constraints and the issue of time poverty. These studies suggest that lower income women, are more time-constrained than men since they often combine work with caring tasks (25). There is also the risk that road-pricing may give lesser benefits to lower income people relative to higher income people, due to a general tendency for lower income people to have a higher marginal utility of money and a lower value of time (26). This suggests that both the dimensions of income affordability and time-poverty resulting from road-pricing schemes could lead to greater transport inequity and social exclusion.

One of the proposed ways to mitigate the negative social effects could be to use (at least some of) the revenues obtained, to improve the public transport system. The
logic is that since that system is disproportionately used by people on lower incomes, this should help to transfer costs from higher-income individuals to lower income ones \((27, 28)\). It has been suggested \((29, 30)\) that recycling the revenue from road-pricing schemes (e.g. into improving public transport alternative) can theoretically serve to remedy decreased accessibility to the road network, provided that \(a\) the costs of toll collection are not too high, \(b\) car dependency is reduced and \(c\) a switch to other modes is not too expensive in monetary or time terms for all current road users. Most of the discussions of the effects of revenue recycling have taken place in an American context, where car dependency is higher, even for low income people \((31)\).

Some authors have taken the position that in the context of European cities like London and Stockholm there is less concern about the equity effects of road-pricing because the majority of lower and middle income residents travel mostly by public transport anyway and so will be largely unaffected by the toll \((32, 28, 33, 34)\). However, empirical, post-implementation analysis of the equity effects of the London Congestion Charge suggested that its equity effects were more complex. In practice, there has been a mixture of potential ‘winners’ and losers (both road and PT users), characterized by a reduction of generalized costs for road users and a decreasing travel time for public transport passengers \((35, 36)\).

Two ex-post studies of the equity effects of the Stockholm Congestion Pricing Scheme have also re-calculated the expected welfare effects on commuters across income, gender, and initial commute mode using observed data on commute mode choice from a panel survey of households before and after the trial \((36, 34)\). The results showed an irregular trend for changes in trip patterns, with the greatest burden of congestion pricing falling on the lowest and highest income groups. Work-hour flexibility was significantly associated with shifts to an earlier departure time, and this, in turn, was correlated with income. In other terms, higher income people showed a more flexible work schedule that allows them to more easily avoid the payment of the congestion toll \((34)\).

**THE MADRID CASE STUDY: DEVISING A METHODOLOGY**

Our paper aims to address the two key research questions regarding the accessibility and social exclusion effects of the MMA, based on the available evidence from evaluation studies of Madrid’s public and private transport systems, namely:

1. How do the market effects, policies, funding and maintenance structures (i.e. road pricing) of the MMA transport system combined with its urban and land use organization affect accessibility capacities and constraints and of individuals who are already experiencing social exclusion?

2. Which social groups are most affected by social exclusion from transport and do they all experience similar or different accessibility problems with the transport system?

Several previous studies of transport equity guide the ‘mixed-methods’ approach we have adopted for our analysis \((37, 38, 39)\). We mobilize the combined results of two
different quantitative and qualitative research studies: i) a quantitative study to estimate a cost burden of a road pricing on road users, especially on lower income users \((12, 40)\) and ii) three, one-hour, focus groups with ten people in each, to analyze the access and use of public transport in the lowest income, southern east area of the MMA. The quantitative analysis also involved the exploitation of the mobility regional survey using the micro simulation model, MARS \((41, 42)\).

**Quantitative measures of the accessibility and the affordability effects**

The literature identifies that there are three key causal factors in people use of public transport: generalized cost, accessibility to infrastructure network and quality of private transport alternative \((43)\). Our research focus is on evaluating the degree of economic and spatial accessibility and the social exclusion risk for low income people living in the MMA. As Levinson has shown \((7)\), equity can be considered from various angles. One of the most common is “vertical or social equity”, which can be understood as the equal or unequal impact that results from the scheme on different groups of the population, distinguished according to income level, sex, available alternative to car, age, or even race \((44)\). In this respect, the income level of users is one of the main variables considered in equity analysis that could be translated in a lower or higher accessibility to the transport systems. From the social exclusion perspective, the most usually disaggregations are according to income, gender, age, ethnicity and car availability \((45)\).

In order to analyse the impacts in terms of monetary accessibility after the implementation of a metropolitan road pricing, we first identified the users who would be most sensitive to the pricing policy scheme, characterized by the lowest per capita incomes by districts within the MMA in which they live. Specifically, we select five districts in the south with the lowest revenue clustered people and other five with the highest revenue clustered people \((46)\), as shown in table I

**TABLE I Income of the M40 users of southern and northern congested sections**

<table>
<thead>
<tr>
<th>Southern Districts</th>
<th>Monthly income per capita (€)</th>
<th>Northern Districts</th>
<th>Monthly income per capita (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Villa de Vallecas</td>
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<td>1696</td>
</tr>
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<td>Rivas Vaciamadrid</td>
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<td>Leganes</td>
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</table>

The road policy implemented is a cordón toll on M-40 metropolitan orbital highways (see Figure 1), characterized by an increasing number of trips, several congested sections, a general dependency on car of its users, a worst public transport
alternative and a difficulty to time shifting. In consequence the accessibility and social exclusion analysis in focused on the southern districts of MMA.

We then estimated the income burden of the congestion cordon pricing on the lowest revenue area of MMA and on the highest revenue zone. In this way, we analysed the accessibility effects of a metropolitan road toll on users with different levels of income in areas with the same levels of road congestion. Demand modeling deals with traffic conditions, as determined by the daily travel behavior of people (47). We employed a travel demand model for private car travelers for the main road network of the MMA, using the roads during the peak hour (7-10 a.m.) of weekdays. An origin-destination matrix (O-D matrix) for the rush hour was obtained from the 2004 Madrid Region Mobility Survey (48), which was conducted with about 35,000 families in the Madrid region who were interviewed about their daily trips. The O-D matrix was calibrated by using 394 data points of traffic flow from the Ministry of Transport and Infrastructures (49, 50). An equilibrium algorithm was used for assignment which means each user selects the route and the mode of least generalized costs; in our case, the generalized cost function includes travel time, operation costs, and the cordon toll.

The users of two most congested section of M40 are characterized by three main factors:

1. Dependency on the car because of the radial form of the public transport networks and the urban sprawling of workplaces and residences that jointly increases travel time ratio between public transport and car (1.62 in average). Actually, the current time ratio between northern and southern districts of MMA are very similar. The starting situations, both of upper and lower income areas, are very similar. However, a future implementation of a road pricing could change the starting situation and produce a worse situation for southern low income area.

2. Travel motives identified basically by work, school or accompanying other people—mainly child to school (i.e. obligatory travel purposes, around 90%) - make difficult to shift the time, and lessen the congestion during the peak hour.

3. Perceived cost by users of public and private transport modes. Three focus groups were realized in southern east area of MMA to detect the perceived cost.

Qualitative study of inhabitants’ perceptions about the transport systems

Focus groups were conducted in two selected of the southern districts characterized by the two lowest travel time ratios between public transport and car (1.62), and by the lowest individual monthly incomes (943€ and 880€) Getafe and Leganes (see Fig.1). This choice of areas was justified by the objective to test people’s perceptions of transport affordability in respect to its generalized costs, including the ratio of time between public transport and car. The focus groups discussions took place between May and June 2011. The participants of the focus groups were recruited by distributing “invitations” to people using any of the public and private transport modes or walking around the stations of public and private transport infrastructures. We also left leaflets at coffee shops, restaurants, shops, apartments and at the University.

We conducted three different one-hour focus group sessions comprising around 10 participants in each in order to capture inhabitants perceptions of various aspects: the
condition of the public transport in the area, the effects of a new road pricing implementation and the suitable design of a transport fare. We had a diverse profile of people attending the sessions: professors/students at universities, professors/students at high school, unemployed people, policy makers, transport authorities, researchers, among others. All participants also completed individual questionnaires completed with socio-economic data and trip information.

FIGURE 1 Map of Madrid Metropolitan Area and M40 ring

ANALYSIS OF RESULTS: ACCESSIBILITY AND THE RISK OF SOCIAL EXCLUSION

In this section of the paper we discuss the main findings from our evaluations of transport affordability for people living in the less rich parts of the south-east MMA. Once categorized by their route choice after the introduction of a cordon toll, we examine the effect of a congestion pricing policy on the income of the users.

Findings from the quantitative study

Results from analysis of Visum model simulator show a clearly increasing level of generalized costs for people’s access to the metropolitan highways road system. Categorizing the road users by their route choice --, A) leaving the M40 and using an alternative less costly path, B) continuing as users of the M40, or C) becoming new users of the M40, an analysis of the burden of the road pricing shows that the new charge to use the metropolitan highway affects the annual incomes of the lowest income groups most. People with maximum per capita incomes 1,000 euros per month are affected by a range of 9% (for new users and still using the highway) and 12% for giving up its use, whereas people with higher income levels suffer an additional burden of between 6.2 – 6.6% (12).
The geographic and institutional unit considered is the district because it is the most stabilized territorial unit. Ideally the analysis would first at low income and rich areas and then consider the circumstances of individuals living within these areas in order to identify winners and losers. However, in the absence of this individual level data we use deprived areas as a proxy for social inequality, although we recognise this is a somewhat sub-optimal approach. Actually, in the case of the MMA, the average income of people living in the considered districts is as well below the average income of all districts. The districts in this area are quite homogeneous from the income point of view (see table I). The current trend of the urbanization by election (i.e. gate community urban system) tends to inhabitants and road users with the same revenue in a specific area of the MMA. A district of the northern part of the metropolitan area was excluded from our analysis as an exception to this norm (i.e. Alcobendas with the rich part of the “Moraleja” suburb).

Of additional note is that the road users that must pay most for the road toll (i.e. 12% of their income) are also the same people who are giving up its use. Furthermore, even if the public transport system is less costly in monetary terms it is less efficient in journey time costs, as demonstrated by the travel time ratio between public transport mode and car mode (table II). As such, these people living in these low income areas also experience increased generalized costs because of their additional journey times. This is because the people who ‘give up’ the tolled highway have to change their mobility strategies; i.e. reduce their use of the tolled roads and find new arrangements for their trips. The choice is either or spend double the time for their commuter trips by switching to the public transport or to not make the trip and simply stay at home – a double disbenefit with serious connotations for encouraging their social exclusion.

By analyzing the consequence of the introduction of a congestion pricing including the effects of modal shift, we see that the situation is similar. Actually, the people living in low income southern area and shifting to public transport after the introduction of the congestion pricing (i.e.25% of the previous M40 users) will experience an increased generalized cost and an additional burden on their per capita income between 11% and 17% (table II). While, the people living in the northern upper income area and shifting to public transport after the introduction of the congestion pricing (i.e.15% of the previous M40 users) will support a lower increased generalized cost and an additional per capita income between 8% and 13% (table II).
TABLE 2 Toll-ring burden on the income of the M40 residents

<table>
<thead>
<tr>
<th>Southern Districts</th>
<th>Monthly income per capita (€)</th>
<th>Income Burden variation (%)</th>
<th>Northern Districts</th>
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<td>1903</td>
<td>8%</td>
</tr>
<tr>
<td>Getafe</td>
<td>943</td>
<td>17%</td>
<td>Las Rozas de Madrid</td>
<td>1719</td>
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<td>9%</td>
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</table>

Adopting the hypothesis that the spatial and financial accessibilities determinant a risk of social exclusion (39), we can conclude that in the south of the MMA the implementation of a cordon toll on the M40 highway produces and increasing social and spatial disparities in the access to the road network. Actually, the new toll affects more the users of lowest income level, because of their high dependency by the car and the consequent expensive modal shift to the public transport mode.

Findings from the qualitative study

Focus groups were conducted in Getafe and Leganes (see Fig. 1 above), with residents, workers and students. There were three key findings which emerged from our subsequent analysis of the group discussions.

Firstly, participants confirmed that they perceive price as a key causal factor in their choice to use private or public transport. People living in the southern districts pay a higher price for transport monthly ticket and perceive it as an exclusionary factor because of their poor connectivity with the centre of Madrid. Secondly, they suggested a problem of connectivity inside of the southern districts. Some new public transport infrastructure projects like Metrosur, for example, have only solved the problem of the connectivity between districts, and even then not always very effectively (38). Thirdly, private transport was described as a big competitor of public transport in terms of its time ratios with the car, specifically for the people living outside of the southern districts and working in these districts. A lower fare price could incentivize these people to choose public transport instead of the car.

It was interesting to find there were similarities in points of view across the different focus group sessions, although they involved different social groups. Students and unemployed people were more aware of transportation monetary costs and fare limitations:

Fifteen years ago, when I was working in Switzerland, I was gaining the same revenue I could get now in Spain. It is true that the current price for a public transport ticket in Madrid could be between 30% and 100% lower than other
European countries, but the minimum salary is also between 50% or 100% lower than other countries. [Unemployed female, 35-45 years, Getafe]

There was a difference in people’s perceptions depending on their age: older people perceived a public transportation improvement in this zone while younger people did not observe this. For example, regarding timetables, older people still remembered the time when if you missed your train (Cercanías) you would have to wait a long time for the next one. Now the frequency has notably increased, almost on a par with the Madrid Metrosur service. These journey time reductions have increased the use of public transport, although there are still issues with the price of fares:

Years ago, when Metrosur was not into operation, if I had to go from Alcorcon to Leganes, I had to go to Madrid first using the commuter rail line, therefore, Metrosur has reduced the travel time although there are issues with the price that I do not agree with”. [Student male, 19 years, Leganés].

It was interesting to note that most of the participants wanted a public transport network that fully connected the five main towns to Madrid City Centre with radial routes rather than the single circular route that is currently available via the Metrosur. When we informed them that the commuter rail line is already offering this service, and after re-thinking the problem, they said that the problem is that rail is not part of the metro system and so not properly integrated because they have to pay for another ticket. This lack of fare integration was what the majority of participants pointed out as most important to them in terms of their use of the public transport. Actually, in Madrid fare integration is possible with a monthly or annual ticket. The use of different network transport systems (i.e. metro and regional railways) is much more expensive than the use of a single mode. The basic fare system is based on Pay as you Live. To live far away from the center means to pay a higher price specially in the case of a single ticket.

Students and unemployed people have a combined ticket to make use of different transport services (commuter rail, bus and metro) at certain times. However, the Transport Authority of Metropolitan region of Madrid, does not offer a decreased fare in the south-east area because it is not seen as cost effective. Recently, the authority introduced a combined ticket at certain times for interchanging between urban buses within 60 minutes inside of the city of Madrid. The periphery of the MMA was excluded from the new fare measure. This has an effect of excluding people in the south-east of the MMA from activities in the city centre. In the words of one participant:

The public transport in the south is fine but it does not take you everywhere. For example, I am unemployed, and if I have to go to a job interview in the industrial part of Getafe, I have to take the Metro from Alcorcon (where I live) to go to Getafe and then wait to the bus, which does not have a high frequency, therefore it takes me years to get to my final destination plus I paid for four rides”. [Unemployed male, 45-60 years, Getafe]

This shows how the high price of the ticket compromises accessibility to a new job. Another unemployed person who attended the meeting agreed and added:
“Actually I even used the car to come to my employment search meeting because it was faster and cheaper than taking other transportation modes”.

[Unemployed female, 35-45 years, Getafe]

Therefore people on very low-incomes living in areas that are served by the MMA road network are highly car dependent and so likely to be highly negatively affected by the introduction of the road pricing scheme.

CONCLUSIONS

The evidence from our combined quantitative and qualitative assessment of the MMA transport system has helped us to draw some important conclusions in relation to our two initial research questions concerning its impacts on spatial equity for different social groups. Firstly, we have demonstrated that changes in the level of access to transport systems caused by a road pricing combined with an expensive and inefficient public transport fare system can produce a very real risk of social exclusion. Road pricing inevitably increases the cost of travel for all drivers but this will disproportionately affect low-income drivers. The analysis of the simulation results of the implementation of the cordon toll to the M40 shows a clear degradation of the conditions of accessibility to transport for low-income users areas and the possibility of increasing social inequalities with a risk of social exclusion (the generalized costs increase by 11% and 17% for low income users).

Secondly, we have identified that the Madrid scheme has significantly increased the travel time costs for low income drivers. Drivers who ‘give up’ the M40, have to find new arrangements for their commuting trips by reducing the use of metropolitan toll roads and spending more time for their journeys by public transport. In this case, an important relationship between accessibility and social exclusion is found (people have less opportunity to travel, reduced access to new job opportunities and less time to participate in life enhancing social activities).

Thirdly, we found that lower income people are not only adversely affected by the decrease in accessibility brought about by the toll but also from the longer journey times of the public transport alternatives. Unemployed people living in the poorer South Eastern part of the MMA are especially negatively affected. The spatial concentration of low-income users in the south of the MMA permit spatially differentiated pricing policy of the congested orbital motorway. However, the high degree of economic dependency of the south to north of the MMA due to the daily flows of workers living in the southern districts and working in the industrial north means that there is no alternative but to travel between these areas for employment.

Finally, in response to the recent tentative suggestions of the Madrid policymakers that the inequity effects of MMA can be reduced by the construction of the new subway line to the south of the MetroSur, our focus groups suggest that they will have few positive effects on the transport inequalities of inhabitants of this area. Our participants indicated that they would prefer to see an integrated and less costly public transport fare system. Our simulation results also highlighted that the implementation of a toll in Madrid orbital urgently needs to be accompanied by an improvement in the ratio of time between public and private transport. A particularly
novel contribution of our research is that it has empirically demonstrated the regressive nature of road pricing scheme even in an European context where, theoretically, car dependency amongst low income population is much lower and their access to public transport is much higher than in the North American context. It is not our intention advocate that road-pricing schemes should not be introduced to relieve traffic congestion in cities, but rather that policy makers need to be more alert to their potentially negative social equity effects and seek to actively ameliorate these effects through appropriate compensatory measures.

REFERENCES


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