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## Linking inequalities in daily mobility and transport expenditure in a Latin-American metropolis. The case of Guadalajara (Mexico)

<sup>1</sup>Lourdes Diaz Olvera<sup>a</sup>, Pierre Lestruhaut<sup>b</sup>, Didier Plat<sup>a</sup>, Pascal Pochet<sup>a\*</sup>

<sup>a</sup> LAET (Transport Urban Planning Economics Laboratory) – Université de Lyon, ENTPE, rue Maurice Audin, 69518 Vaulx-en-Velin Cedex, France

<sup>b</sup> Ministerio de Obras Públicas y Transportes, Costa Rica

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### Abstract

In metropolitan areas that are experiencing marked spatial growth, access to activities and resources afforded by the city is far from universal. This is primarily due to socio-geographical disparities in the distribution of urban services and jobs. However, in cities of the global South the situation is further worsened by major inequalities in the use of motorized transport modes, not only cars but also public transport which is too expensive for poor city-dwellers to use on a regular basis. In order to take better account of socio-spatial equity issues and improve accessibility to urban resources and opportunities, it is necessary to strengthen our knowledge on mobility inequalities taking into account simultaneously transport expenditure and levels of mobility.

We analyze data from two household surveys undertaken in 2007–2008 in the metropolitan zone of Guadalajara, the second biggest Mexican conurbation with more than 4 million inhabitants, to estimate inequalities in daily mobility and transport expenditure. We assess the impact of the equivalence scale on the measure of inequalities. Expenditure and travel behavior indicators are then analyzed according to income level and place of residence. The results highlight the fact that transport is a major component of household expenditure and that there are considerable inequalities between households. Even though regular use of motorized transport is unaffordable for poor populations, they are not totally excluded from motorized mobility due to the diversity of types of public transport. The inhabitants of the most distant zones have to make trade-offs between a high proportion of transport expenditure in their budget and daily mobility restricted to the residential neighborhood.

*Keywords:* transport expenditure; daily mobility; modal share; socioeconomic inequality; spatial inequality; household survey; Guadalajara

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\* Corresponding author. Tel.: 00-33-472047741.

E-mail address: [pascal.pochet@entpe.fr](mailto:pascal.pochet@entpe.fr)

## 1. Introduction

The rapidly growing population of Latin-American countries is highly concentrated in cities. In 2010, four out of five Latin Americans live in urban areas (CAF, 2012). Rural-urban migration and intra-urban residential mobility entail informal extensions in the fringes of the urban areas, with poor infrastructures and services. In these contexts, the transport system play a more palliative than structuring role (CAF, 2011). Even if the monocentric model seems today less relevant for Latin American metropolises that have begun a transition process towards a more polycentric model (Lazo, 2012), the levels of spatial and economic segregation are still high, with the rich living in the central areas and the poor more geographically dispersed. For the specific case of Mexico, socioeconomic segregation appears relatively lower than in other Latin American countries (Monkkonen, 2012a) but the reform of the housing finance system launched in the early 1990s led to the emergence of large areas where only registered salaried employees are able to afford housing, and has contributed to increasing segregation (Monkkonen, 2012b). The multiplication of gated communities for the rich, the stigma and the rejection of areas where poverty is dominant result in new patterns of way of life, the withdrawal on the domestic sphere and the use of private car for the upper classes, the withdrawal on the neighborhood for the poor (CAF, 2012). To what extent transport policy is targeting specific needs of the poor and can contribute to break away from these patterns?

As mobility is costly, the access to mobility, as well as accessing and consuming goods and services of all nature, is not ensured in an egalitarian way for all the inhabitants of an urban area. This unequal access can lead to an exacerbation of economic and social inequalities in the population, insofar as access to urban resources is a prerequisite for gaining more income, social resources or improving human capital (Diaz Olvera et al., 2010; Hernandez, 2012). Mobility is therefore considered at the same time as a key vector of economic and social integration, and as a major contributor to the fostering and reinforcement of inequalities and to social exclusion (Lucas, 2012). There is little doubt that differences between individuals' travel behaviors exist, as for other components of the way of life. When such differences can be interpreted as disadvantages with regard to daily mobility, they are perceived as inequalities if they are due to situations that are partially or completely unchosen. Numerous factors can then contribute to mobility inequalities: economic resources, gender, age, place of residence, etc.

In the cities of the global North, the issues raised by the unequally distributed access to the city and by the daily mobility of the poor have been studied more extensively than in the cities of the South. The problems generated by the inequalities of mobility are more pronounced for different reasons that are tightly linked to the uncontrolled urban sprawl, the spatially unequal distribution of gainful employment, social services and basic utilities, the numerous deficiencies in public transport supply, the limited economic resources of a majority of city dwellers, and the low motorization rate of households (Diaz Olvera et al., 2010, 2013). More recently, more researches have focused on travel behavior in large Latin-American cities. They have studied more precisely the social and economic characterization of differences of accessibility and daily mobility, the affordability of public transport for poor households and individuals (Calonge Reillo, 2016, Falavigna and Hernandez, 2016; Falavigna and Nassi, 2013; Hernandez, 2012, 2015; Paquette, 2010) and the consequences of difficulties and restrictions in mobility on social exclusion of city-dwellers living in urban fringes or low-income communities (Oviedo Hernandez and Titheridge, 2015; Oviedo Hernandez and Davila, 2016; Maia et al., 2016).

In this paper, we will focus our analysis of mobility inequalities on economic and spatial factors, which may be subject to remedial public policies, with the goal of fostering a more equitable access to mobility and consequently to urban resources. For measuring vertical inequalities (related to unequal distribution of incomes and expenses) and spatial inequalities (resulting from the uneven availability of jobs, shopping facilities and services on the metropolitan territory) we use two families of indicators: transport expenditure (total, by mode, etc.) and mobility level (number of trips, distance budget, etc.). The case study is the metropolis of Guadalajara, the second biggest urban center of Mexico, for which two recent surveys, on household budget and on travel behavior, are available in open access. Section 2 describes the metropolis of Guadalajara. Section 3 presents the data and the methodology. Mobility inequalities are measured and analyzed firstly through economic indicators (section 4) and then through travel behavior indicators (section 5). Section 6 summarizes the analysis.

## 2. Guadalajara: the metropolis and the transport provision

The metropolitan area de Guadalajara (MAG), located in the state of Jalisco, in the western part of Mexico, is composed currently of eight municipalities: Guadalajara, Zapopan, San Pedro Tlaquepaque, Tonalá, Tlajomulco de Zúñiga, El Salto, Ixtlahuacán de los Membrillos, and Juanacatlán (Fig. 1). The last two municipalities, which were the last to be integrated into the MAG, are still little concerned by urbanization and remain on the whole rural areas.

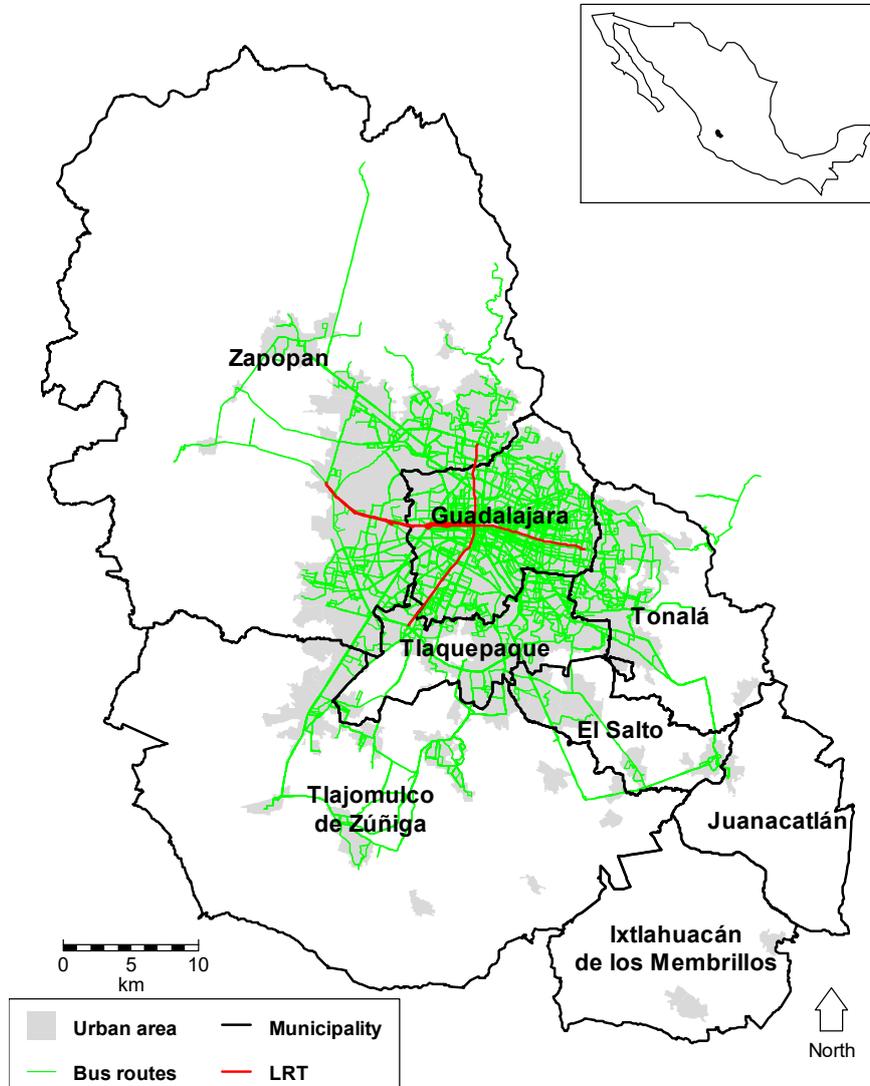


Fig. 1. Municipalities of the metropolitan area of Guadalajara (map from the authors; source: INEGI).

According to the 2010 population census, the MAG is the second biggest Mexican conurbation, with 4.4 million inhabitants, which represent 60% of the population of the federal state of Jalisco (INEGI, 2011). The original city was founded in the middle of the 16<sup>th</sup> century in the municipality of Guadalajara by the Spanish conquerors and remains the core of the conurbation. Almost 62% of the population is concentrated in Guadalajara and Zapopan, while only barely 14% live in the most rural municipalities (Table 1).

Table 1. Distribution of the population of the metropolitan area of Guadalajara according to the municipality in 2010.

Municipality	Population (%)	Density (inhab/km <sup>2</sup> )
Guadalajara	33.7	9,874
Zapopan	28.0	1,069
San Pedro Tlaquepaque	13.7	5,506
Tonalá	10.8	2,882
Tlajomulco de Zúñiga	9.4	584
El Salto	3.1	1,573
Ixtlahuacán de los Membrillos	0.9	203
Juanacatlán	0.3	96
Metropolitan Area of Guadalajara	4,434,878	1,622

Source: INEGI, 2010

As many Latin American metropolises, the MAG has been experiencing significant rural immigration from the surrounding municipalities or federal states during several decades. This process has contributed to rapid urban sprawl, increasing demand for housing, strong real state pressure and property speculation. For example, in the 1970's, the conurbation included only two municipalities (Guadalajara and Zapopan) while in the 1980's it extended to San Pedro Tlaquepaque, in the 1990's to Tonalá, and in the years 2000's to the other four municipalities. Simultaneously, the population growth in the municipality of Guadalajara first slowed down the 1970's and 1980's and then the number of inhabitants of Guadalajara began to diminish since the 1990's. The population growth in the municipalities located in the first periphery has been increasing constantly (LAHN, 2009a). Many social housing programs for low-income households have been implemented since the 1970's by the public authorities in the peripheral zones, increasingly farther away from the city center. New housings are also located in peripheral unplanned areas, sometimes inappropriate for residents because of geographical and environmental conditions (LAHN, 2009b; Macías Huertas et al., 2009).

The spatial segregation of population in the MAG is observed since the 1960's (Camberos Gambiri, 1993, LAHN, 2009b): the high-income populations in the west and north-west, the middle classes in the center, north and south-west, and the low-income populations in the north-west, north, east and south. A greater concentration of public and private investments for infrastructures and facilities in the western part of the MAG (Rodríguez Gómez et al., 2009) than in other areas contribute to sustain this spatial pattern.

The Mexican National Council for Population (CONAPO) has developed the CONAPO indicator of exclusion in urban settings which measures the economic and social exclusion of households according to a combination of specific indicators in the fields of education, health and housing (Consejo Nacional de Población, 2013). According to this indicator, the degree of exclusion is very low in the western zones of Guadalajara and in Zapopan while it is average or low in most of the other zones of the conurbation. However, high levels of exclusion are found in the distant periphery, particularly in the municipalities of Tonalá, Tlaquepaque and El Salto and pockets of very high levels of exclusion in all the peripheral municipalities.

The motorization rate in the MAG is still low, compared to the motorization levels in the countries from the global North<sup>2</sup>. With data from INEGI, ITDP estimated that in 2010 there were about 275 cars per 1000 inhabitants in the MAG (Medina Ramírez, 2012:20).<sup>3</sup> Consequently, the majority of the population rely only on walking or public transport. The public transport provision currently consists of several transport modes:

<sup>2</sup> In the United Kingdom, for example, there were 465 cars per 1000 inhab. in 2010 ([http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger\\_cars\\_in\\_the\\_EU](http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_cars_in_the_EU).)

<sup>3</sup> This value is greater than for the Mexico metropolitan area (about 260 cars per 1000 inhab.) and less than for other Mexican conurbations near the USA border, around 315 cars per 1000 inhab. in Monterrey, nearly 450 cars per 1000 inhab. in Tijuana.

- Two light rail lines (*Tren ligero*). Line 1 follows a north-south direction and serves the municipalities of Guadalajara, Zapopan and Tlaquepaque while line 2 links the center to the municipality of Tonalá;
- A high-capacity bus line (*Pre-tren*) that extends the light rail line 1 towards the west;
- A Bus Rapid Transit line (*Macrobús*) that serves since 2009 the municipalities of Guadalajara, Tlaquepaque and El Salto. Several bus routes were also implemented to feed the BRT;
- Buses and minibuses. Several parapublic and private companies operate bus routes in urban and suburban zones; the exact number changes frequently because of the division of enterprises. Lopez Dodero (2013) mentions 17 companies and other sources mention a dozen companies in 2010;
- Two trolleybus lines are operated by the parapublic bus company Sistecomzone;
- Taxis, that are used extensively in Guadalajara, as in other large Mexican cities.

According to the Observatory of Urban Mobility in Latin America (*Observatorio de Movilidad Urbana* - OMU; CAF, 2010), 31% of all trips in the metropolitan area of Guadalajara are made in public transport modes, 32% in personal vehicles (car, motorcycles, bicycles, and including taxis), and 37% on non-motorised transport modes.<sup>4</sup> Compared to other cities studied by OMU, Guadalajara shows the lowest figures for the modal share of public transport modes (CAF, 2011; Lopez Dodero, 2013).

### 3. Data and methodology

For this research we conducted secondary analyses of two database available in open access. They were produced with information collected in two household surveys carried out at nearly the same period, 2007-2008.

Chronologically, the first survey is the household travel survey implemented in 2007 by CEIT (*Centro Estatal de Investigación de la Vialidad y el Transporte*). It collected information on 5,534 households, which included 19,227 individuals. The main information concerning individuals was the following: sex, age, household status, level of education, activity status, income level, opinions on problems encountered when using transport, especially public transport. The survey also collected the main characteristics of their urban trips undertaken the day before the interview: origin and destination, hours of departure and arrival, trip purpose, transport mode and, when appropriate, the cost of riding public transport and parking charges, stated preferences of the mode of transport. The database is available online on the website of the BIIACS (*Banco de Información para la Investigación Aplicada en Ciencias Sociales*).

The second survey is the 2008 National household income and expenditure survey (*Encuesta Nacional de Ingresos y Gastos de los Hogares* - ENIGH) that was conducted by the Mexican agency in charge of statistics (*Instituto Nacional de Estadística y Geografía* – INEGI). The sample consists of 1,427 households living in the metropolitan area of Guadalajara. This survey collects information on the household demographic and social characteristics, characteristics of the dwelling, assets owned by the household, amount and distribution of household incomes and expenditures. The collection of transport expenditure concerns the following items: expenditure for each public transport mode (metro, tramway, bus, “micro-bus”, school transport, taxi, other) and for private vehicles, purchase of new vehicles, insurance, maintenance and fuel costs. The survey database is available in open access on the INEGI website.

These surveys used different geographical divisions to locate households in the metropolitan area. The geographical division which is common to the two surveys is rather aggregated and geographical comparisons can only be made at the municipality level.

In the ENIGH survey, expenditures for household vehicles do not distinguish the urban and interurban use of vehicles. According to Medina Ramirez (2012), in Mexico, the annual total mileage of cars is about 15,000 km and the part of urban mileage is approximately 75%. In the absence of more disaggregated figures to estimate the part of vehicle expenditure concerning car use in urban settings, in this research we adopt the proportion of 75%.

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<sup>4</sup> For example, the share of public transport modes in the Mexico metropolitan area is 52%, in Monterrey 47%, and in Puebla 47% (Lopez Dodero, 2013).

In order to assess inequalities between households it is necessary to rank households in increasing order according to their standard of living (Diaz Olvera et al., 2015). In this research, the standard of living is based on the household income in the case of the household travel database and on the amounts spent by the household in the ENIGH database. The distribution of households in quintiles (each quintile designates 20% of households) then allows to compare the values of indicators for the different quintiles. As usual, the first quintile designates the poorest 20% of the population and the fifth quintile, the richest 20% of the population.

To convert the household income (or expenditure) into standard of living, economists use an equivalence scale that expresses, on the one hand, the differing needs of different members of the household (for example, according to age), and on the other hand, the economies of scale that result from household size (for example, a single refrigerator may be enough for a household of a single person or several persons). Numerous equivalence scales can thus be designed and in the absence of a consensus among academics to support a particular equivalence scale, it is useful to test the sensitivity of results to various scales (Muller, 1997; Ekström, 1998; Deaton and Zaidi, 1999). In this research we tested four different equivalence scales:

- the total income (or expenditure) scale, which does not take into account the household size;
- the per capita scale, in which income (or expenditure) is divided by the household size. The needs of all the household members are considered equal, whatever their age or status.
- the modified OECD scale (also called “modified Oxford” scale) weights the needs of individuals differently according to age: 1 for the first adult, 0.5 for the other adults aged 14 years old and over and 0.3 for the members aged less than 14 years old;
- the CONEVAL scale, designed specifically for the Mexican context by the *Consejo Nacional de Evaluación de la Política de Desarrollo Social*, takes into account the children’s age: 1 for the household head, 0.99 for each of the other adults (aged 19 years old and over), 0.70 for each member aged 5 years old or less, 0.74 for the members aged 6 to 12 years old, 0.71 for the members aged 13 to 18 years old (Consejo Nacional de Evaluación de la Política de Desarrollo Social, 2009).

The comparison of results concerning the socio-economic characteristics (see Fig. 2 for the household size) and transport expenditure (Fig. 3) show that for each quintile values are fairly similar in the case of three equivalence scales: per capita, modified OECD and CONEVAL. Given that the per capita scale is frequently used in works on inequality because it is simply to use, and hence allows for intra and cross-national comparisons, we will use the per capita equivalence scale in the following analyses.

The quarterly amounts of transport expenditure are given in Mexican pesos 2008.

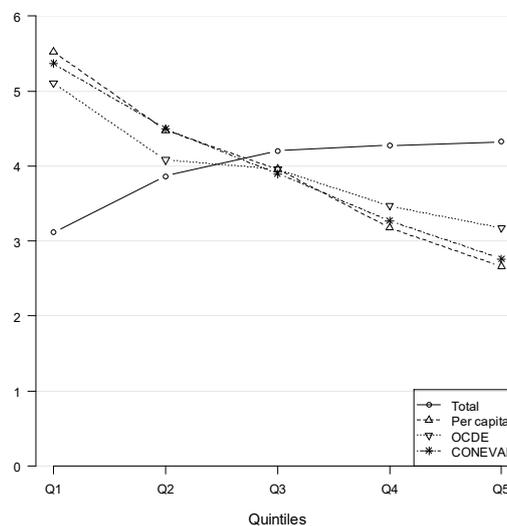


Fig. 2. Household size according to the income level, using different equivalence scales.

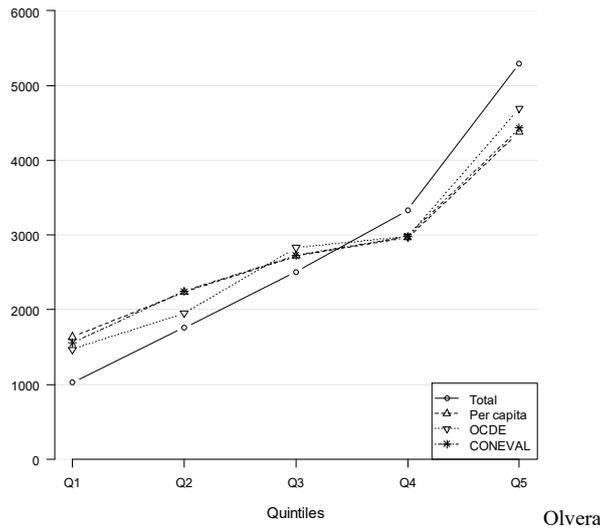


Fig. 3. Amount of urban transport expenditure (except vehicle purchase) according to the income level, using different equivalence scales (in pesos 2008).

#### 4. Results: transport expenditure

Unsurprisingly, household car ownership is clearly related to income and the lowest value is for the poorest households (Q1), while the highest value is for the most affluent (Q5), i.e. 34% of Q1 and 79% of Q5 owns at least one car (Fig. 4). On the opposite, two-wheelers (bicycles and motorcycles) are more frequent among low-income households. Consequently, total transport expenditure is distributed differently depending on the income level (Fig. 5). The households of the poorest quintile spend most on public transport (78%) and the proportion is still high for those of the second quintile (60%). The amounts spent for the purchase of personal vehicles are very small in the case of the first two quintiles. The richest households spend mostly on the purchase and use of personal cars. Lastly, the expenditure distributions of the third and fourth quintiles are very similar and most of transport expenditure is devoted to personal vehicles.

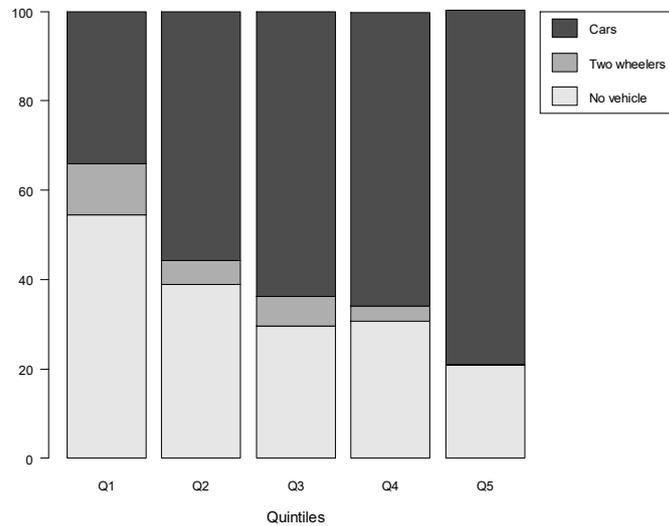


Fig. 4. Household vehicle ownership according to per capita income quintile (%)

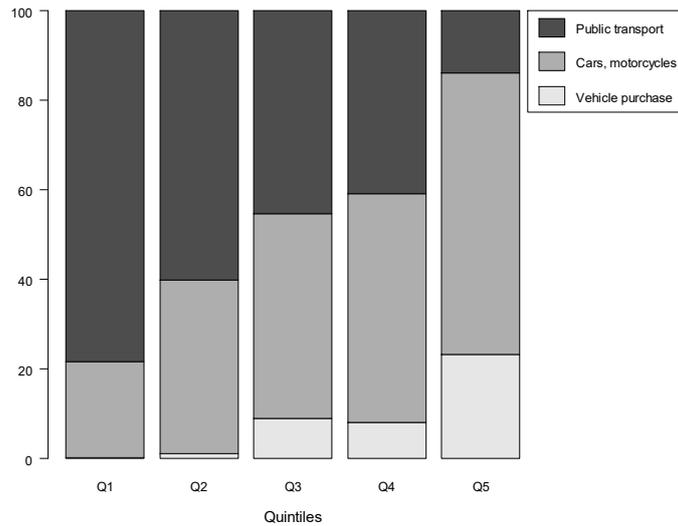


Fig 5. Structure of urban transport expenditure according to per capita income quintile (%)

Given that the use of cars is more costly than riding in public transport, the monthly amounts spent by households on cars and motorcycles increase regularly from the first to the fourth quintile, and then more sharply, between the fourth and the fifth quintiles (Fig. 6). Moreover, the very low amount spent by the households of the first quintile suggests that motorized households rely less on their vehicles to ensure mobility than the households belonging to the other quintiles. With regard to the amount spent on public transport, the contrast between quintiles is striking: it is rather constant between the first and fourth quintiles and then it declines markedly for the fifth quintile.

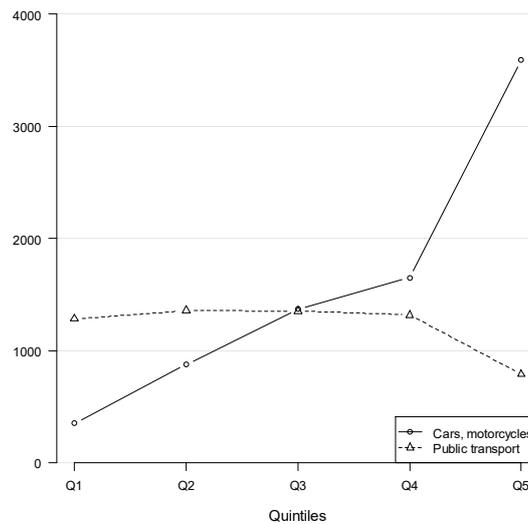


Fig. 6. Transport expenditure for personal vehicles and public transport according to per capita income quintile (Mexican pesos 2008)

Fig. 7 highlights the fact that public transport modes are used differently according to the household income. Bus and light rail are not included in the figure as they account for a stable proportion of public transport expenditure, around 60% of income. The share of expenditure devoted to microbus, which is the less formal and less expensive transport mode drops by half between the first and the last income quintiles. On the opposite, households of the fourth and fifth quintiles use more frequently a more flexible and comfortable transport mode (taxi), or a mode which allows children attending private schools to travel in better safety and security conditions (school bus services).

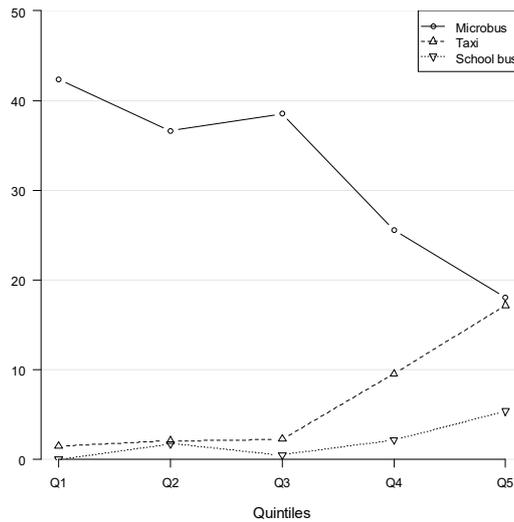


Fig. 7. Public transport expenditure devoted to microbus, taxi and school buses according to per capita income quintile (%)

The concentration indexes confirm that the inequality of transport expenditure is mainly related to inequalities in household car ownership and use (Table 2). All car-related expenditures (purchase, as well as maintenance and fuel) are highly concentrated according to income. This is not the case of public transport expenditure, with the exception of taxi, the most expensive public transport mode.

Table 2. Concentration index of transport expenditure according to household per capita income quintile.

Expenditure	
Urban transport expenditure	0.327
Urban transport expenditure (except vehicle purchase)	0.188
Personal vehicle (except vehicle purchase)	0.387
Public transport	-0.067
of which: microbus	-0.188
of which: taxi	0.382

The size of the household diminishes with income. Households in the poorest quintiles are the largest (6.5 individuals on average, less than 3 individuals in Q5) and the household transport budget must meet the mobility needs of a larger number of individuals than the more affluent households. The use of the indicator “expenditure per person” sheds new light on inter-household inequalities of transport consumption (Fig. 8). The use of personal vehicles is even more concentrated in Q5, the wealthiest quintile. They spend 10 times more the amount spent by the individuals from the poorest households and more than twice the amount of the individuals from the households of the fourth quintile. Also, the monthly public transport expenditure per person increases from 232 pesos in Q1 to 415 pesos in Q4 (+79%) but then declines to 297 pesos in Q5 (-28%), due to the intensive usage of personal vehicles by the wealthiest households. In the lower quintiles the number of young children is higher and their needs for motorized mobility are more limited. To take into account this situation, if the total public transport expenditure is divided by the number of individuals aged 13 years old and over, the differences between Q1 and Q4 are still significant (+44%).

Low income households are characterized by a deficit in the use of public transport and the corresponding expenditure, mainly because of a tight household budget. After the effect due to income, the residential location in the MAG appears as a secondary. There is no difference in the amount of transport expenditure according to the municipality of home in the case of the intermediate quintiles (Q2, Q3 and Q4), with the exception of a drop for

households in Q4 living in the more remote and rural municipalities (Tlajomulco de Zúniga, El Salto, Ixtlahuacán de los Membrillos, Juanacatlán). A closer analysis shows that in these municipalities, the poorest households (Q1) are characterized by a particularly low amount of transport expenditures (-30% compared to the households of the same quintile living in more central and urbanized municipalities), and the richest by a high amount (+60%). These findings suggest that mobility behaviors differ significantly in the most distant periphery: the poorest have a local mobility while the most affluent travel long distances to reach the central area.

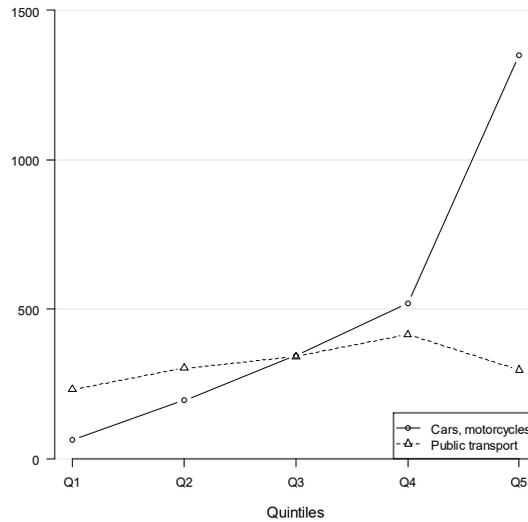


Fig. 8. Transport expenditure per person for personal vehicles and public transport according to per capita income quintile (Mexican pesos 2008).

**5. Results: travel behavior**

The analysis of the 2008 household travel database gives complementary information on social inequalities that affect travel behavior in the metropolitan area of the capital of the Jalisco state. In line with inequalities in transport expenditure, modal split appears closely related to the economic resources of the household. In a context where the number of trips remains stable according to income, the modal split shows significant differences in the share of walking: it is over 50% in Q1, around 50% in Q2, and still over 40% in Q3, but falls below 30% in Q4 and below 20% in Q5 (Fig. 9b.). The increase of motorized mobility along the income scale reveals a growing use of the car, from 12% in Q1 to 56% in Q5. The share of public transport is stable around 31 to 33% in the first four quintiles and drops to 24% in Q5. The household travel database confirms that the use of taxis increases notably with income (Table 3). The share of two-wheelers (bicycles account for 80% and motorcycles for 20%) is slightly higher in the first three quintiles. As a consequence of these differences in the modal split, the mean trip duration and length increase with income, and then the travel time budget and travel distance budget increase continuously from the first to the fifth quintile (Fig. 9a.).

Table 3. Use of taxi according to income quintile

	% of taxi in overall public transport trips	Number of trips Index base 100 =mean
Q1	1.7	65
Q2	2.5	100
Q3	2.4	100
Q4	2.7	118
Q5	4.0	135
All	2.5	100

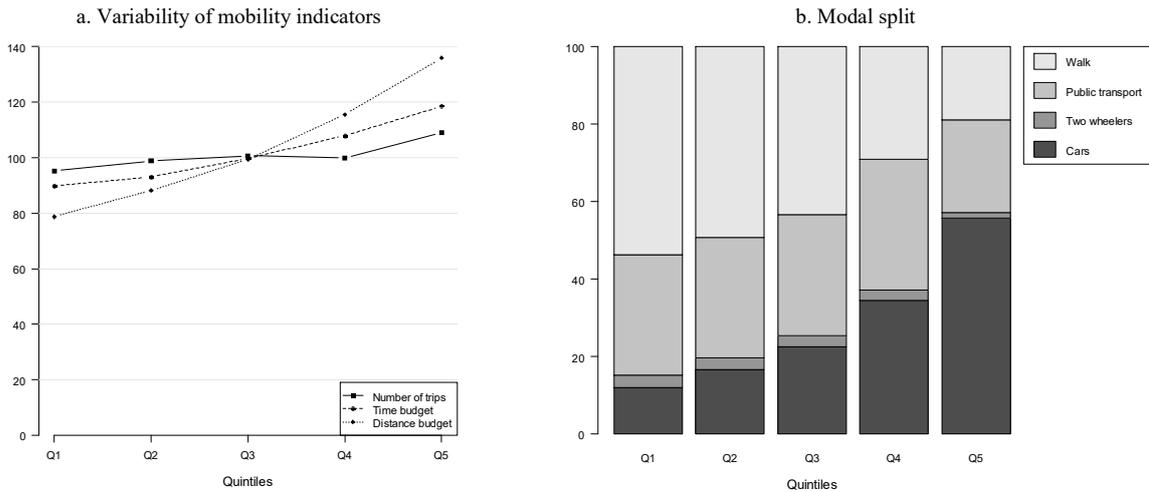


Fig. 9. Variability of mobility indicators (a.; base 100 = global mean) and modal split according to per capita income quintile (b.; %)

In the MAG, the effect of the residential location is lesser than the household income but differences are still significant and they are worth focusing on them. Once more, the results from the two databases are consistent. The effect of the home location is measured with the “as the crow flights” distance between the place of residence and the city center (Fig. 10a, 10b). The residents living in the central areas rely slightly more on the private car and less on public transport (33.5% and 28% of all trips, respectively), than, for example, those living in the intermediate periphery, located at 7,5-10 km from the city center (27% and 32%, respectively). The individuals who live more than 15 km from the center have a specific travel behavior: by far the lowest shares for car and public transport (16% and 23%, respectively) and the highest shares for walking and two-wheelers (57% and 4%, respectively). With the exception of this case, the use of walk as a transport mode increases slightly from the center to the 10-15 km ring (35% and 40%, respectively). These results appear as counter-intuitive, as population, job and service densities are much higher in the center than in the outskirts.

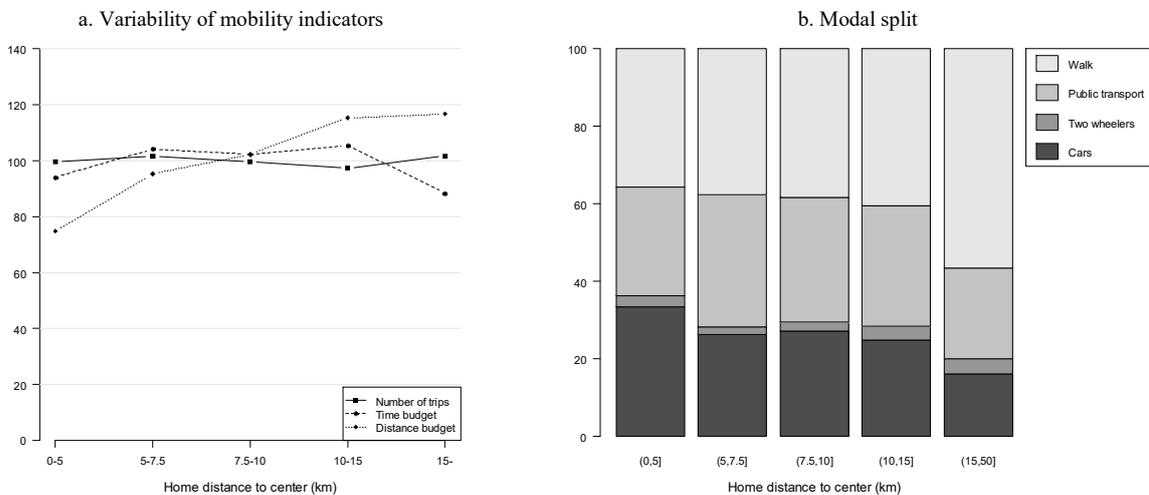


Fig. 10. Variability of mobility indicators according to distance to center (a.; base 100 = global mean) and modal split, according to residential location (b.; %)

The cross analysis of the effects of income and distance to the city center on travel behavior confirms the fact that household income is more influential than the residential location, even if the outer, less urbanized residential zones are very specific, and they induce at the same time a long daily travel distance budget, especially for the richest, and

a high share of pedestrian trips, especially for the poorest (Table 4.a and 4.b). These inequalities are not explained by a larger proportion of young children among the poorest households. Focusing the same cross-analysis to the 13 and more gives way to differences almost as large as those measured for all the age classes.

Table 4a: Pedestrian trips for the extreme quintiles and rings (%)

% of walk trips	Center (0-5 km)	Outer ring (15-50 km)	All zones of residence
Q1	49.0	69.5	53.7
Q5	18.0	30.2	18.9
All quintiles	35.7	56.7	40.7

Table 4b: Total travel distance budget for the extreme quintiles and rings (km)

Daily distance traveled (mean)	Center (0-5 km)	Outer ring (15-50 km)	All zones of residence
Q1	7.0	9.8	9.1
Q5	11.7	24.4	15.8
All quintiles	8.1	14.4	11.6

Obviously, inequalities in daily mobility and the corresponding expenditures are closely linked to other sociodemographic differences or inequalities. Life cycle stage and economic activity are critical factors in understanding inequalities in mobility practices. For example, households classed in the poorest quintiles usually include a significant number of individuals who are not in work (children, housewives, older persons). This situation may hinder their mobility, as they have a low access to car and are economically dependent of other household members for the satisfaction of their basic needs, including their travel needs. However, even among the population in employment classed in the first quintile, the use of a personal car is quite rare and most of their trips are made either with public transport or walking. Their inequalities in mobility are significant, as for the inactive population.

Gender-based inequalities are also strong in the metropolitan area of Guadalajara. Even if, on average, women travel as much as men, their distance budget is smaller than for their male counterparts. The source of these inequalities may be found in the gender differences in daily activities. Housewives make more trips than other population groups, and most are short-distance trips, for example, for shopping and escorting their children to school. Their daily travel distance budget is therefore half of the working women's budget. Nevertheless, gender inequalities are also visible among the active population: car use is mainly reserved to working men while working women ride public transport and walk more frequently. These disparities are observed in all quintiles and they can be considered as relatively independent from income inequalities.

## 6. Conclusion

The analysis of two complementary household surveys carried out within the same geographical perimeter (the metropolitan area of Guadalajara) and nearly at the same period (2007 and 2008) bring knowledge on travel behavior related to disparities among households with regard to their economic situation. Before summarizing the main results of this study, we will mention some of its limits, principally due to the unavailability of more specific data:

- In the household income and expenditure survey, the most precise geographical division is the municipality level, which does not allow analysis at a fine geographical scale. However, our analyses already show that even at the municipal level there are differences in the consumption patterns.
- Information on interurban mobility is not available. It could be useful to gain more knowledge on the ratio intra-/inter-urban car trips, which can vary, for example between the richest and the poorest groups of households.
- The household travel survey does not collect data on trips undertaken during the weekend days. Therefore, we cannot assess if weekend mobility compensates or amplifies the mobility inequalities observed for the weekdays.
- Both surveys provide only the income and expenditure at the household level. The existence of marked intra-household inequalities can then be assessed only partially, particularly with regard to mobility. Information on income and expenditure at the individual level could allow deeper analyses.

Both surveys give a snapshot of transport inequalities in Guadalajara for the late 2000s. Since then, some important changes have taken place: the global economic conditions have evolved, a BRT line (*Macrobus*) has been implemented, the public transport network has also undergone some adjustments, etc. Nevertheless, several major lessons can be learned from this research:

- The variability of travel behavior and the corresponding expenditure is high. The 20% richest households spend 2.7 times more for daily mobility than the 20% poorest households and they travel 1.7 times more kilometers.
- People living more than 15 km away from the center use motorized modes less frequently than those who live in the center, but their daily distance budget is much higher (+76%).
- The inequalities resulting from economic resources are stronger than the inequalities related to the place of residence, both in terms of costs and trip characteristics (number of trips, travel time budget and travel distance budget). The preeminence of the economic factor results from the very close link between available money and daily modal choice.
- Public transport expenditure per person increases sharply between the first and fourth income quintiles. Individuals belonging to households of the first income quintile have very limited access to costly cars, travel more on foot (and by bicycle) and are somehow limited quantitatively and qualitatively to use public transport. Thus, the income and social hierarchy reflects in a modal hierarchy.

In the Guadalajara metropolitan area, as in many metropolises of developing countries, it is essential for most city dwellers, and particularly for the poor, to be able to travel by public transport and to access to the city. Urban amenities are more numerous in the center of the metropolis and accessibility to these central locations is more difficult for the inhabitants of the most distant suburbs, as illustrated by the case of the households of the first quintile living more than 15 km from the center. In these areas, the number of public transport routes and the bus frequencies are low. Also, intermodal public transport trips are costly because of the lack of fare integration. Affordability of public transport for the poor should be a major concern for public authorities.

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